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St. Paul, MN 55144

Title: Fluorochemical Exposure Assessment of Decatur Chemical and Film Plant Employees

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QUALITY ASSURANCE STATEMENT

TITLE OF STUDY: Fluorochemical Exposure Assessment of Decatur Chemical and Film Plant Employees

The above study was examined for quality assurance in keeping with the spirit of The Guidelines for Good Epidemiology Practices for Occupational and Environmental Epidemiologic Research as published by the Chemical Manufacturers Association Epidemiology Task Group. The final report was determined to be an accurate reflection of the data obtained. The dates of Quality Assurance activities on this study are listed below.

Study Initiation Date: 09/03/98 Study Completion Date: 08/11/99

TYPE OF AUDIT:	DATE OF AUDIT	DATE FINDINGS REPORTED TO PRINCIPAL INVESTIGATOR AND STUDY DIRECTOR	DATE FINDINGS REPORTED TO 3M MANAGEMENT
Protocol, Draft Protocol Addenda, Data File, Draft Final Report	06/28/99	06/28/99	06/28/99
Final Report	08/09/99	08/09/99	08/09/99

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ABSTRACT

In the past, employees at the 3M Decatur chemical plant have voluntarily participated in a fluorochemical medical surveillance program. Analysis of the surveillance data has not shown significant associations between the employees' clinical chemistry and hematology tests and either total serum organic fluorine or serum PFOS (perfluorooctane sulfonate) levels. However, the voluntary nature of the historical medical surveillance program did not provide for a complete understanding of the distribution of fluorochemical serum levels in the Decatur workforce. Therefore, the purpose of this study was to collect data by randomly sampling employees in the Decatur chemical plant in order to determine the distribution of employee serum fluorochemical levels according to demographics, current and longest held jobs, years worked and building locations. In addition, a random sample of the neighboring 3M Decatur film plant employee population, located at the same site, was tested to determine fluorochemical serum levels in order to characterize the differences between the two plant populations.

A total of 232 employees was randomly selected for serum sampling: 186 (80%) participated in the blood collection which occurred in the Fall, 1998. An additional 77 employees requested blood testing for the determination of fluorochemical levels. Of the random sample of employees who participated, 126 were from the chemical plant and 60 from the film plant. There were 61 volunteers from chemical and 16 volunteers from film; thus, all chemical participants numbered 187 employees and all film participants numbered 76 employees. At the time of blood collection, employees responded to a two-page questionnaire that inquired about their current and longest held jobs, the buildings

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they had worked in (if chemical employees), and possible routes of oral ngestion of fluorochemicals through cigarette smoking, chewing gum, chewing tobacco and hand washing practices.

Sera samples were extracted using an ion-pairing extraction procedure. The extracts were quantitatively analyzed for PFOS (perfluorooctane sulfonate), PFHS (perfluorohexane sulfonate), POAA (perfluorooctanoic acid), PFOSAA (N-ethyl perfluorooctanesulfonamido acetate) PFOSA (perfluorooctane sulfonate amide), M570 (N-methyl perfluorooctanesulfonamido acetate) and M556 (perfluorooc anesulfonamido acetate) using high-pressure liquid chromatography/electrospray tandem mass spectrometry (HPLC/ESMSMS) and evaluated versus an extracted curve. PFOS, PFHS, POAA, PFOSAA and PFOSA levels were determined by Northwest Bioanalytical Laboratory. M570 and M556 levels were determined by the 3M Environmental Laboratory.

The overall arithmetic means (and range) and the geometric means and (95% confidence interval) of the random sample of chemical employees (n = 126) for the seven fluorochemicals are presented below (in ppm):

Chemical Plant

Arithmetic Mean (and Range)			Geometric Mean (and 95% CI)		
PFOS	1.505	(0.091-10.600)	PFOS	0.941	(0.787 - 1.126)
PFHS	0.345	(0.005 -1.880)	PFHS	0.180	(0.145 - 0.223)
POAA	1.536	(0.021 - 6.760)	POAA	0.899	(0.722 - 1.120)
PFOSAA	0.023	(0.001 - 0.269)	PFOSAA	0.008	(0.006 - 0.011)
M570	0.151	(0.008 - 0.992)	M570	0.081	(0.067 - 0.098)
PFOSA	0.062	(0.0005 - 0.612)	PFOSA	0.013	(0.009 - 0.018)
M556	0.052	(0.001 - 0.406)	M556	0.022	(0.018 - 0.029)

The overall arithmetic means (and range) and geometric means (95% confidence interval) of the random sample of film plant employees (n = 60) for the seven fluorochemicals are presented below:

Film Plant

Arithmetic Mean (and Range)			Geometric Mean (and 95% CI)		
PFOS	0.172	(0.015 - 0.946)	PFOS	0.136	(0.114 - 0.161)
PFHS	0.023	(0.001 - 0.210)	PFHS	0.014	(0.011 - 0.018)
POAA	0.071	(0.006 - 0.298)	POAA	0.049	(0.039 - 0.062)
PFOSAA	0.004	(0.001 - 0.038)	PFOSAA	0.003	(0.002 - 0.003)
M570	0.020	(0.001 - 0.454)	M570	0.008	(0.006 - 0.011)
PFOSA	85% of samples < LLOQ*		PFOSA	85% of samples < LLOQ*	
M556	0.008	(0.0001 - 0.307)	M556	0.003	(0.002 - 0.004)

LLOQ = lower limit of quantitation for PFOSA ranged from 0.001 - 0.010 ppm.

The above values showed high variability according to the employees' demographics, work history and building locations. Among the random sample (n = 126) of chemical employees, cell operators had the highest serum levels of PFOS (geometric mean = 1.970 ppm) and PFHS (geometric mean = 0.697 ppm). However, sera from chemical operators and maintenance workers had the highest levels of other fluorochemical analytes (PFOSAA, M570, PFOSA and M556) a characteristic likely due to their work in Buildings 3 and 4N with fluorochemical alcohols, amides and acrylates. For example, chemical operators had a geometric mean level of 0.131 ppm for M570 compared to 0.033 ppm for cell operators, 0.042 for mill operators and 0.079 ppm for waste operators. POAA levels were above the geometric mean of 1.000 ppm for employees with current jobs of cell operators (1.428 ppm), chemical operators (1.887 ppm), maintenance workers (1.095 ppm) , mill operators (1.266 ppm) and waste operators (1.542 ppm). Employees with the job categories of engineer/lab and secretary had the lowest serum fluorochemical levels. PFHS, and to a lesser extent PFOS, were positively associated with years worked in the chemical plant. The remaining fluorochemical analytes were not routinely associated with years worked in the chemical plant by job categories. We did not observe an association between hand-to-mouth usage or hand cleanliness (frequency of washing hands) and serum fluorochemical levels.

Like their male counterparts, female chemical operators appeared to have increased PFHS levels with years worked. However, unlike their male counterparts, there was no apparent modest linear association between PFOS and years worked among female chemical operators. Whether this is due to different work practices, exposure patterns or pharmacokinetics once absorbed, remains to be determined. The sample size itself (n = 10 female chemical operators in random sample), is an important, limiting factor in the interpretation of these data.

The data also indicate significantly lower serum fluorochemical levels among employees who have only worked in the film plant (i.e., defined as those employees in the random sample who have worked only in the film plant with no prior work on the D-1 maker located in the film plant or previous work history in chemical. The D-1 maker uses FX-1801, a methyl FOSE amide). There were significantly lower serum fluorochemical levels among these employees who have only worked in the film plant when compared to those who are current chemical plant employees. Comparing the geometric means for each fluorochemical from the random sample of chemical operators and those employees who only have worked in the film plant, we observed the following ratios (in ppm): PFOS (1.481/0.110); PFHS (0.428/0.015); POAA (1.887/0.052); PFOSAA (0.011/0.002); M570 (0.229/0.022); and M556 (0.044/0.003). Except for PFOSAA, these ratios suggest a 10-fold or greater difference between chemical operators and film plant employees who work several hundred yards away from Building 3. This only film plant employee group had a geometric mean value for PFOS that is approximately 3-4 times higher than the pooled geometric mean (0.029 ppm) from 64 samples obtained from 18 U.S. blood banks. Thus, we suspect that occupational exposure to PFOS does occur within the film plant although at much lower levels than among employees working at the chemical plant. Additionally employees who worked on the D-1 maker have serum PFOS levels approximately 3 times higher than those employees who have never worked on the D-1 maker nor have worked in the chemical plant (i.e., the only film plant employees).

We did not observe an association between hand-to-mouth usage or hand cleanliness (frequency of washing hands) and serum fluorochemical levels. It is possible an association might have been masked because industrial hygiene had instituted an aggressive educational campaign several months prior to the collection of blood samples in this study; thus current practices may not be indicative of past practices. Because the half-life of PFOS is estimated to be 1000 days or more, such an association may not be discoverable with this study design.

A limitation to this study design which must be considered in the interpretation of the data was our inability to more accurately quantify an employee's work history experience. Decatur work history records provide department numbers and job titles but they do not provide information regarding where someone worked (e.g., what building(s) or with what specific fluorochemicals). Self-reported work history information obtained by questionnaire was highly correlated with Decatur work history record information; nevertheless, the specificity of where someone worked and with what chemicals was not known. Because many operations are in batch mode, the likelihood of determining specificity of historical workload fluorochemical exposure among chemical operators was not possible.

The present study's sera fluorochemical levels, observed by job categories and building locations, strongly support the recommendations borne from recently conducted industrial hygiene assessments. These recommendations include specific engineering controls to reduce inhalation exposure, appropriate personal protective equipment to prevent overexposure and appropriate personal hygiene practices among employees to remove skin concentrations.

Finally, PFOS and POAA serum levels measured in this study are similar to those that have been previously reported via past biennial medical surveillance activities. Results of previous epidemiologic studies have not associated the serum PFOS or POAA levels observed in this study population with hepatic, lipid or hormone abnormalities.

INTRODUCTION

In the past, employees at the 3M Decatur chemical plant have voluntarily participated in a fluorochemical medical surveillance program. The surveillance program analyzed for total serum organic fluorine levels until the mid-1990's when serum perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (POAA) determination, quantifiable by high performance liquid chromatography mass spectrometry, became incorporated in the biennial medical surveillance examinations. Analysis of the surveillance data has not shown significant associations between the employees' clinical chemistry and hematology tests and either total serum organic fluorine levels [Roach, 1982; Schuman, 1982] or serum PFOS levels [Olsen et al., 1999]. However, the voluntary nature of the medical surveillance program may not lend itself to an appropriate characterization of the distribution of fluorochemical serum levels as it is not based on random sampling methods. Therefore, the purpose of this study was to collect data from the necessary distribution by randomly sampling employees in the Decatur chemical plant in order to determine the distribution of employee serum fluorochemical levels according to demographics, current and longest held jobs, years worked and building locations. In addition, a random sample of the neighboring 3M Decatur film plant employee population, located at the same site, was tested to determine fluorochemical serum levels in order to characterize the differences between the two plant populations.

The film plant employees have served as a comparison population in a prior health study (Mandel and Johnson, 1995) due to their (assumed) nonoccupational exposure to fluorochemicals. However, their actual serum fluorochemical levels had not been discerned. Epidemiologic studies at the Decatur plant can be more fully appreciated if the distributions of employee serum fluorochemical levels at both the chemical and film plants are better understood.

METHODS

Description of Decatur Facility

The 3M Decatur site is located in Decatur, Alabama which started production in the early 1960's. The site consists of two plants, Specialty Film "film plant" and Specialty Materials "chemical plant". Both plants are in the Specialty Materials Manufacturing Division (SMMD). The chemical plant is located several hundred yards directly east of the Film Plant. The main buildings located on the site are Buildings 1, 2, 3, 5, 14, 15, 17, 19, 31, 36, 38, 40, 42, 48, 49, 51, 57, 59 and 61 (see Appendix A). Buildings 14, 15 and 19 are considered film plant buildings. Buildings 1, 2, 3, 31, 38, 40, 42, 48, 49, 51 and 61 are considered chemical plant buildings. Building 5 is the boiler house that controls site utilities such as chilled water, plant steam, plant nitrogen and breathing air. Building 5 is located southwest of the chemical plant. Building 17 serves as the maintenance and stockroom building located just west of Building 5 servicing mainly the chemical plant. Buildings 36 and 57 are site wastewater treatment buildings located east of the chemical plant.

The major production buildings in Decatur film plant are Buildings 14, 15 and 19. Polyester and non-polyester films are produced in Building 14. Maintenance, locker rooms, and dining facilities are all located in areas of Building 14. Resin used in film production is manufactured in Buildings 15 and 19. The only process in the film plant using fluorochemicals is run on the D-1 film line (called the D-1 make). The process uses FX-1801 in the production of film used for a limited number of products. Currently, no other processes in the film plant use fluorochemicals in production.

The three major products produced in the chemical plant are protective chemicals, performance chemicals, and fluoroelastomers. The three product groups are referred to as focus factories. Fluorochemicals identified in this study are used in all focus factory groups to some extent. Production for all focus factories takes place in Buildings 2, 3, 4, 38, 40, 42, 49, 51 and 61. The chemical plant's main office areas, warehouse and quality control labs are located in Building 1. The chemical plant's dining facility and locker rooms are located in Building 31.

Raw materials and intermediates for each product group may flow through many different production buildings before they are packaged for shipping. The flow of protective chemicals follow a path starting at Building 3 to Buildings 2 or 49 to Buildings 3, 4, 38 or 51. The protective chemicals group is the primary producer of perfluorooctane sulfonyl fluoride (POSF) and perfluorohexane sulfonyl fluoride (PHSF) based chemistry. Octyl mercaptan or hexyl mercaptan is reacted with chlorine and ammonium fluoride to produce octane sulfonyl fluoride (OSF) or hexane sulfonyl fluoride (HSF) in Building 3 and is referred to as the 'cell feed'. The cell feed is sent to Buildings 2 and 49 where it is reacted in electrochemical cell systems to produce POSF or PHSF. POSF is the major sulfonate based fluorochemical produced at Decatur. PHSF is produced mainly for fire suppression liquids. Most of the POSF produced is piped to Building 3 where amides, alcohols, acrylates and other fluorochemical polymers are produced. These fluorochemical polymers are then used in all production buildings to produce intermediates and finished goods.

The performance chemicals are mostly made up of inert liquids and fire suppression liquids. The inert liquids follow a path starting at Buildings 2 or 49 to Buildings 40 or 42. Inert liquids consist of mostly perfluoronated alkanes and do not contain sulfonate or carboxylic acid compounds. Fire suppression liquids are primarily based on sulfonate chemistries starting with POSF and PHSF. Fire suppression products are made in Building 3 and packaged in Building 4.

Fluorochemicals are used in the production of fluoroelastomer products. The first part of the fluoroelastomers is called latex, which is produced in Buildings 4, 38 and 51. The latex is then coagulated, washed and milled in Buildings 4 and 61. POSF based compounds are the primary fluorochemicals of interest used in the majority of fluoroelastomer products. POAA is also used in a limited number of fluoroelastomer product runs. POAA is used in the production of latex that is eventually coagulated, washed, and milled in Buildings 4 and 61. This POAA containing product is run infrequently, only several times per year. POAA is also a by-product within the electrolytic cells and is carried through up to product. It is believed to be a result of increased oxidation within the cells. POAA was produced in Building 2 and subsequently worked up in Building 3 more than 20 years ago and had not been produced in Decatur since the time of this study. POAA production is expected to resume in Buildings 2 and 49 in the near future.

Sample Size Determination

Three critical factors were considered to decide the sample size for this study. First, it was important that a sample be randomly chosen from the employee populations of both the chemical and film plants. Second, the sample size was driven by the need to provide confidence that the exposure in the film plant is small relative to that of the chemical plant. Third, the sample size had to adequately characterize the exposure levels within the chemical plant workplace. In addition, all employees in the chemical and film plant had to be offered the opportunity to know their fluorochemical levels via blood testing, although they may not be part of the random sample. The random sample size in this study of more than 200 subjects was based on: 1) the lower 95% confidence bound of the hypothesized mean difference between the serum fluorochemical levels of the chemical plant; and 2) to allow for adequate characterization of serum fluorochemical differences by job and building within the chemical plant (see study protocol for details). There was an added degree of uncertainty in estimating sample size because approximately 10 percent of the film plant employees may have had prior work experience in the chemical plant. Also, an unknown number of film plant workers had worked on the D-1 maker where a PFOS-based fluorochemical (FX 1801, a methyl FOSE amide) has been used.

The random sample was chosen by the following methods: a) all full-time current chemical and film plant employees were identified via a current plant roster that listed departments and supervisors; b) using a random number generator algorithm, a sample of employees was chosen which was proportionate to the number of employees who worked in the various chemical departments, auto and chemical markets group, Decatur EHS&R, Dyneon, and the film plant. We included in the random sample all identified Decatur site employees who were assigned to the wastewater treatment plant (Buildings 36 and 57). Altogether, there were 232 employees randomly chosen to participate in the study (Table 1). A total of 186 (80%) participated and 46 (20%) refused. The film plant random sample had the lowest participation rate (71%). In addition to the 186 random sample participants, there were 77 employees from the chemical (n = 61) and film (n = 16) plants who requested their serum be tested for fluorochemical levels. Hereafter, these individuals will be called the "volunteers."

Employee Study Participation

Study participation required the following: 1) a signed consent form by the employee; 2) a written response to a brief questionnaire (Appendix B) that inquired about current and past work history along with the frequency of hand washing and use of gum, chew (tobacco) and cigarette habits of the employee while at work; and 3) a venipuncture with the collection of two vials of blood (approximately 20 cc) for the determination of the seven fluorochemicals. The study protocol was approved by the 3M Institutional Review Board (IRB).

Each randomly chosen employee (film and chemical) received a letter of invitation to participate that was jointly signed by the plant manager (Mr. Jim King) and the 3M Medical Department director (Dr. Larry Zobel). There was plant-wide communication which described the purpose of this study and encouraged employee participation. All study participants, who were either randomly chosen or who volunteered, were informed of their own individual results by a letter sent to them from the 3M Medical Department in July, 1999. Aggregate results of the study were also communicated at that time to the employees.

Fluorochemical Analyses

All blood was collected in the months of October and Novemb·r, 1998 at the Decatur plant by MedAccess (an occupational health clinic located in Decatur, Alabama) under the direction of Cathy Simpson, RN who centrifuged the blood to obtain the serum and then shipped the samples to the 3M Medical Department (St. Paul MN). Split samples were catalogued by Diane Madsen and Jean Burris and then sent to either Northwest Bioanalytical (Dr. David Vollmer) for determination of per luorooctane sulfonate (PFOS), perfluorooctane sulfonate amide (PFOSA), perfluo ohexane sulfonate (PFHS) , perfluorooctanoic acid (POAA) and N-ethyl perfluorooctane ulfonamido acetate (PFOSAA) or to 3M Environmental Laboratory (Dr. Kris Hansen) for determination of N-methyl perfluorooctanesulfonamido acetate (M570) and perfluorooctanesulfonamido acetate (M556).

In both laboratories, sera samples were extracted using an ion-pairing extraction procedure. The extracts were quantitatively analyzed for PFOS, PFHS, POAA, PFOSAA, PFOSA, M570 and M556 using high-pressure liquid chromatography/electrospray tandem mass spectrometry (HPLC/ESMSMS) and evaluated versus an extracted curve. There were minor differences between the analytical methods used at Northwest Bioanalytical and 3M Environmental Laboratory. Most notably, Northwest Bioanalytical evaluated analyte levels versus a curve extracted from human sera. Endogenous levels of certain fluorochemicals were determined in the standard matrix and additional fluroochemical was spiked into the matrix. The total amount of each specific fluorochemical (endogenous + spiked) was used to construct an extracted standard curve. For the analysis conducted at the 3M Environmental

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Laboratory, the difficulties presented by the endogenous levels of fluo ochemical in samples of "blank" test matrix were circumvented by utilizing rabbit se ra as a surrogate matrix. Previous research had shown that rabbit sera contains the low st level of endogenous fluorochemicals when compared to sera from bovine, rat, monkey and human.

As a quality control check, the 3M Environmental Laboratory screened PFOS levels in approximately 10% of the sera analyzed at Northwest Bioana ytical. While most of the results agreed to within ± 25%, 14 of the 40 samples checked showed lower (>± 25%) values when analyzed at 3M. It is expected that these discrepancies are due to differences in curve slope and intercepts arising from the analytical differences described above. Given that Northwest Bioanalytical satisfactorily completed a method validation for PFOS using human sera and given that most values were in close agreement with those obtained by the 3M Environmental Laboratory using a rabbit sera curve, data from both laboratories were considered accurate to within the parameters defined by their methods. Details of both laboratories' methods and final reports are reported elsewhere [Vollmer, 1999; Hansen, 1999].

Data Analysis

Each employee's questionnaire data and computerized work history records were reviewed to determine whether the employee was: a) a current chemical employee (regardless of any work experience in the film plant); b) a film plant employee with no history in chemical; or c) a film plant employee with prior history in chemical. Employees who were considered Decatur 'site' employees (e.g., safety, industrial hygiene) and who stated they currently worked in one or more chemical buildings were considered to be chemical employees in the data analyses.

Employees were asked to provide their current and longest-held job. A review of these job titles by an industrial hygienist (PWL), epidemiologists (GWO, JMB) and occupational health nurse (CAS) categorized the entries into eight job classifications for the chemical plant: cell operators, chemical operators, engineers/laboratory, maintenance, mill operators, secretaries, supervisors/management and waste operators. Film plant current jobs (and longest held jobs) were categorized into four job classifications: engineers/laboratory, film processors, maintenance and administrative. These classifications were done prior to any data analyses. The individual's usual job assignment when he/she worked overtime was not analyzed as most persons reported this was the same as their current (or longest held) job. Employees were asked on the study questionnaire to indicate the number of years they have worked in chemical. This information correlated with a review of records from the epidemiology unit's Decatur work history database for those employees with 7000 level department codes; thus these self-reported data were used to assess years worked in chemical. On the other hand, years worked in film were calculated from the epidemiology unit's Decatur work history database because this information was not requested on the study questionnaire. Chemical employees who had worked previously in the film plant were identified and classified as to their time of service in the film plant (< 1980, 1980-1989 and 1990-1998).

Age was calculated from the employee's date of birth from the epidemiology unit's Decatur work history database. Body mass index (kg/m^2) was calculated based on the information provided by the employee on the questionnaire. An index of hand-to-mouth contact was calculated based on whether the person smoked cigarettes, chewed tobacco or chewed gum. An index of hand washing was based on whether or not the employee said they always washed their hands before eating while at work.

Through the use of SAS and JMP and employing standard statistical techniques (student's t test, chi square, ANOVA, single and multivariable regression using linear and nonlinear analyses), data analyses concentrated on the following issues: 1) compare responders and nonresponders in the random sample by their demographic characteristics (e.g., age, gender, years worked); 2) compare mean serum fluorochemical levels within the chemical plant by a) employee demographics, b) self-reported work history data based from the study questionnaire including current job, longest-held job, years worked in chemical and in which chemical buildings; c) work history information supplemented with data from the 3M epidemiology unit's computerized comprehensive work history record database for the Decatur site, and d) personal habits (also identified on the study questionnaire) that were hypothesized to increase the likelihood of oral ingestion of fluorochemicals (e.g., hand washing, cigarette smoking, chewing tobacco and chewing gum); and 3) likewise, compare mean serum fluorochemical levels within the film plant by similar factors. To prevent misclassification of potential workplace exposure experience to fluorochemicals within the film plant, we analyzed samples from film plant employees according to those who have and have never worked in the chemical plant as well as those who were identified as having worked on the D-1 maker located in the film plant. Film plant employees who had never worked on the D-1 maker nor ever worked in chemical are hereafter referred to as "only film plant employees."

Because the serum distributions for PFOS, PFHS, POAA, PFOSAA, M570, PFOSA and M556 appeared log normally distributed (a skewed distribution), natural log transformations of the fluorochemicals were performed to calculate geometric means

($e^{(\text{sum} \ln x)/n}$) and statistical calculations regarding central tendency were primarily based on the geometric mean. The random variable X is said to have a log normal distribution if log X is normally distributed, that is, if X is of the form e^Y where Y is normal (i.e., the normal bell shaped curve). The pertinent properties of a log normal distribution can then be derived from properties of the normal distribution. The mean and variance are of the normally distributed Y, that is, of log X. The log normal distribution finds applications in a wide variety of fields including exposure assessments in nature (whether of humans, mammals, etc).

Provided in Appendices C and D are the histograms of the seven fluorochemicals as measured for employees in the chemical and film plants, respectively, using statistics derived from the normal distribution along with the natural log transformation of the distribution. The Shapiro-Wilk W test suggests the necessity of the log transformation. Measures of central tendency routinely presented throughout this report will include the arithmetic mean and range, and the geometric mean and associated 95% confidence interval. Comparisons of geometric means were conducted using the student's t test with statistical significance considered at $p < .05$.

All fluorochemical measurements were reported in parts per million (ppm) to the third decimal point. For statistical purposes, serum fluorochemical values that were less than the lower limit of quantitation (LLOQ) were assumed the midpoint between zero and the LLOQ. Of the total number (n = 186) of employees considered to be currently working in chemical who participated in the study (126 from the random sample and 60 volunteers), the following numbers (in parentheses with percentage) had reported LLOQ's by the measured fluorochemical: PFOS (1, 0.5%); PFHS (1, 0.5%); POAA (0, 0%); PFOSAA (49, 26%); M570 (0, 0%); PFOSA (36, 19%); and M556 (8, 4%). Of the total number (n = 76) of employees considered to be current film plant (60 in the random sample and 16 volunteers), the following numbers (in parentheses) had reported LLOQ's by the measured fluorochemical: PFOS (1, 1%); PFHS (2, 2%); POAA (0, 0%); PFOSAA (29, 38%); M570 (0, 0%); PFOSA (65, 86%) and M556 (32, 42%). We chose not to analyze PFOSA among the film plant employees because 85% of them had serum PFOSA measured at less than LLOQ which resulted in minimum variability for statistical considerations. The LLOQ for PFOSA ranged, between analyses, from 0.001 to 0.010 ppm. Analyses focused on the random sample but aggregate data analyses were also conducted for all participants (random sample and volunteers) stratified by the two plants.

RESULTS

Comparison of random sample responders and nonresponders

Responders (n = 186) and nonresponders (n = 46) from the random sample were compared by age, gender and years worked and found to be alike. Among the chemical random sample, the average age was 42 years compared to 43 for nonresponders. Responders and nonresponders have worked, on average, 16 years. There was a similar 5 to 1 ratio of male to female employees for the responders and nonresponders among chemical employees.

Film plant employees who responded were, on average, 46 years of age, had worked 19 years and the ratio of male to female was 5 to 1. Nonresponders were 48 years of age, had worked 25 years and had a 7 to 1 male to female ratio. Thus, nonresponders in the film plant random sample were slightly older, worked longer and a greater percentage were males.

Overall Findings

The arithmetic mean (and range) of the random sample as well as the geometric mean and (95% confidence interval) of chemical employees (n = 126) for the seven fluorochemicals are presented below (in ppm):

Chemical Plant

Arithmetic Mean (and Range)			Geometric Mean (and 95% CI)		
PFOS	1.505	(0.091-10.600)	PFOS	0.941	(0.787 - 1.126)
PFHS	0.345	(0.005 -1.880)	PFHS	0.180	(0.145 - 0.223)
POAA	1.536	(0.021 - 6.760)	POAA	0.899	(0.722 - 1.122)
PFOSAA	0.023	(0.001 - 0.269)	PFOSAA	0.008	(0.006 - 0.011)
M570	0.151	(0.008 - 0.992)	M570	0.081	(0.067 - 0.098)
PFOSA	0.062	(0.0005 - 0.612)	PFOSA	0.013	(0.009 - 0.018)
M556	0.052	(0.001 - 0.406)	M556	0.022	(0.018 - 0.029)

The arithmetic mean (and range) of the random sample as well as the geometric mean and (95% confidence interval) of the film plant employees (n = 60) for the six fluorochemicals are presented below:

Film Plant

Arithmetic Mean (and Range)			Geometric Mean (and 95% CI)		
PFOS	0.172	(0.015 - 0.946)	PFOS	0.136	(0.114 - 0.161)
PFHS	0.023	(0.001 - 0.210)	PFHS	0.014	(0.011 - 0.018)
POAA	0.071	(0.006 - 0.298)	POAA	0.049	(0.039 - 0.062)
PFOSAA	0.004	(0.001 - 0.038)	PFOSAA	0.003	(0.002 - 0.003)
M570	0.020	(0.001 - 0.454)	M570	0.008	(0.006 - 0.011)
PFOSA	85% of samples < LLOQ*		PFOSA	85% of samples < LLOQ*	
M556	0.008	(0.0001 - 0.307)	M556	0.003	(0.002 - 0.004)

LLOQ = lower limit of quantitation for PFOSA ranged from 0.001 - 0.010 ppm.

Because the above values may be highly variable by employees' demographics, work history and personal habits, subsequent analyses will focus on each plant separately.

Tables 1 - 21 provide the results from the chemical plant. Tables 22 - 29 provide the results from the film plant.

Chemical Plant

Provided in tables 2 and 3 are the demographic characteristics by the number of chemical employees (and percent) from the random sample (n = 126), volunteers (n = 60) and all chemical participants (both random sample and volunteer, n = 186). The distribution of demographic characteristics between the random sample and volunteers were comparable although the random sample had a higher percentage of chemical operators (37%) than did the volunteers (28%).

The mean, median, range and geometric mean of the random sample, volunteers and all chemical participants, is provided in Table 4 for the seven fluorochemicals. The range of PFOS was from 0.091 - 10.600 ppm. Although the geometric means were consistently higher in the random sample than volunteers, only with PFOSA did the geometric mean differ significantly between the random sample (0.013 ppm) and the volunteers (0.006 ppm). It should also be noted that among the random sample, five employees had serum PFOS levels ≥ 5 ppm compared to none among the volunteers. Because the demographic characteristics and geometric means did not substantially differ between the random sample and volunteers, subsequent tables will report on either the random sample and/or all chemical participants. The volunteers will not be presented separately.

Presented in Table 5 are the demographic characteristics of the random sample of chemical employees by current job category (cell operator, chemical operator, engineer/lab, maintenance, mill operator, secretary, supervisor/management and waste operator). Supervisors/management (mgmt) and waste operators were the oldest with mill operators the youngest. Mill operators have worked considerably less years, on average, than all other job categories. This is to be expected since mill operator is an entry level position for new employees. The number (and proportion) of female employees were similar between the chemical operators and the engineer/lab group.

Provided in table 6 is the mean, median and geometric mean for each of the seven fluorochemical levels by gender, hand-to-mouth contact, wash hands and whether the individual had worked only in the chemical plant. Geometric mean levels for males were significantly higher than females for PFOS, PFHS, POAA and M570. We did not observe, as hypothesized, that hand-to-mouth contact (via use of cigarettes, chewing tobacco or chewing gum) and less frequent hand washing resulted in higher fluorochemical serum levels. Also, having worked only in chemical did not result in higher serum fluorochemical levels. We did observe that the further back in time that chemical employees worked in the film plant, the larger their geometric mean values were, as measured in this study. For example, the geometric mean values for chemical employees who last worked in the film plant prior to 1980, between 1980-1989, 1990-1998 and never worked in the film plant were 1.656 ppm, 1.551 ppm, 0.786 ppm and 0.700 ppm, respectively. Of course, this is also a reflection of the number of years worked in the chemical plant (to be presented later in this section). That is, the employees who worked in the film plant prior to 1980 had subsequently the longest continuous work history in chemical since 1980.

Fluorochemical levels by current job category are presented in Table 7. Several observations were noteworthy. First, the distribution of high-to-low geometric mean values varies by current job categories. Cell operators have the highest geometric mean level of PFOS. The next group are the chemical operators, maintenance and waste operators. Supervisor/mgmt is next, followed by the group consisting of mill operators, engineer/lab and secretary. For PFHS, cell operators have the highest geometric mean level. The next highest group appears to be chemical operators, waste operators, supervisor/mgmt and maintenance. For POAA, chemical operators appear to have the highest levels followed by the group consisting of cell operators, maintenance, mill operators and waste operators. Chemical operators and maintenance have significantly higher levels of M570 than all other current job categories. Chemical operators, maintenance and mill operators have the highest geometric mean values for PFOSAA. PFOSA and M556 values were significantly higher for chemical operators than for most other job categories.

Fluorochemical ratios (PFOS/PFHS, PFOS/POAA, PFOS/(PFOSSA+M570+PFOSA+M556), M570/M556, PFOSAA/M556 and PFOSA/M556) are presented by current job category in Table 8. The cell operators had the lowest PFOS/PFHS ratio and the mill operators had the lowest PFOS/POAA ratio. The largest PFOS/metabolite ratio was for the cell operators.

Tables 9-11 are identical to Tables 7-9, respectively, except that the employees' longest job is analyzed instead of the current job category. Cell operators are not included as there was only one cell operator who stated this was his longest job held. The highest PFOS, PFHS and POAA levels were observed among chemical operators. Maintenance and chemical operators had higher M570 and PFOSAA levels. Overall, results did not vary substantially between current job and longest held job.

Table 12 is restricted to only those chemical employees who stated on the questionnaire that they currently work in just one location (building). Because building location is synonymous with job category for cell operators, Buildings 2/49 had the highest PFOS and PFHS levels. Building 3 and Building 4N represented the areas with the highest POAA levels although only one building, Building 1, had substantially lower POAA levels when compared to the other locations. M570, PFOSAA and M556 levels were highest in Building 3. Buildings 3 and 4MX (MX = mixer/extruder area) appeared to have comparable levels of PFOSA. Among the 5 employees who only worked in Building 4N, there was a wide range of PFOSA levels.

Because employees may currently work in only one building but have had a past history of working in several buildings, we further restricted the analyses to only those employees who said they have only worked in one building throughout their employment. This restricted the number of subjects to just 21 individuals (17% of the random sample) with representation in these Buildings: 1, 3 and 4MX. Table 13 shows that PFOS levels were more than 5 times higher in the sera of Building 3 workers than in the sera of Building 1 or Building 4MX workers. PFHS levels were almost 10 fold higher. POAA levels were twice as high in sera of Building 3 workers compared to Building 4MX workers and more than 15 times higher than Building 1 workers. M570 and M556 levels were 5 times higher in Building 3 workers than Buildings 1 or 4MX. PFOSAA and PFOSA levels were comparable between Building 3 and Building 4MX workers and lowest in Building 1.

Tables 14 through 21 provide similar data analyses as the previous tables but now represent the 187 total (random sample and volunteers) chemical participants. There were no substantial differences between the analyses of the random sample and of all chemical participants. For example, among all chemical participants, mill operators were the youngest employees (Tables 14, 17); most female employees were either in the current and longest job category of chemical operators or engineer/lab (excluding secretary) (Tables 15, 18); cell operators had the highest PFOS and PFHS serum levels and engineer/lab, secretary and mill operators had the lowest PFOS and PFHS serum levels (Tables 16, 19); and chemical operators and maintenance workers had the highest levels of M570 and tended to also have the highest serum levels of PFOSAA, PFOSA and M556. Fluorochemical levels stratified by where employees only currently work (Table 20), or have only ever worked (Table 21), were also comparable with the results from the random sample. All chemical participants who have only worked in Building 1 had lower fluorochemical levels than Building 3 workers for all seven fluorochemicals (Table 21). Building 1 workers had lower PFOS, POAA, PFOSAA and PFOSA levels than Building 4MX employees. PFHS, M556 and M570 levels were similar in Building 1 workers and Building 4MX workers.

A series of multivariable analyses (data not shown) examining each fluorochemical by several independent variables (e.g., age, body mass index, gender, current job, longest-held job, whether employed only in the chemical plant, years worked in the chemical plant) suggested there may be up to three important explanatory variables. These were current (or longest) job, years worked within the chemical plant and gender.

To better visualize the influence of years worked within chemical on serum fluorochemical levels, we stratified the analyses by current job categories. In other words, the dependent variable (i.e., each specific fluorochemical) was regressed on years worked in chemical for each separate job category. These linear regression analyses employed the untransformed as well as transformed (natural log) dependent variable. Analyses were conducted for the random sample (n = 126) as well as for all chemical participants (n = 187). Presented in Appendix E are the analyses for each fluorochemical for the random sample (n = 126) and then separately for chemical operators, engineer/lab, maintenance, mill operators and supervisors/mgmt. Cell operators and secretaries are not presented because of their insufficient population.

From the scatterplots and models presented in Appendix E, the following were observed. (Note: in Appendices fluorochemicals are presented in the following order PFOS, PFHS, POAA, PFOSAA, M570, PFOSA and M556. For the scatterplots, upper and lower 95% confidence curves are provided of the fitted line. First, for the entire random sample, only the PFHS model fit the data well with 22 percent of the variation of PFHS explained by an increase in years worked in chemical. PFOS levels increased modestly with years worked in chemical although the variance explained remained small ($r^2 = .10$). Although intercepts may have been significant for other fluorochemical models for the entire random sample, the variance explained was consistently quite small (i.e., less than 3 percent); thus such models have minimum prediction. Among chemical operators the most significant observation was the finding of a linear increase of PFHS levels with increasing years worked in chemical. Thirty-four percent of the variation in PFHS was explained. There were weaker positive linear associations between POAA or PFOS and years worked in chemical. On the other hand, there appeared to be a suggestion that the highest levels of the fluorochemical analytes (PFOSAA, M570, PFOSA and M556) were most often observed among chemical operators with just one or two years of experience. Among the engineer/lab group, there was a weak association between serum PFOS levels and years worked in chemical. The strongest association observed among maintenance workers was the linear increase of PFHS levels with years worked in chemical. Like the chemical operators, a significant amount of variation was explained (26 percent) although the data were sparse. Among the supervisor/mgmt group, PFOS, PFHS and POAA increased with years worked in chemical. Approximately 15 percent of the variation was explained in each model. Model fit was poor for the mill operators because all but two had worked for 5 years or less; thus only scatterplots are presented (not regression models).

The natural log transformations are presented in Appendix F for all chemical employees (n = 126) in the random sample as well as for the two current job categories with the most numbers (chemical operators and engineer/lab). For the entire random sample, a weak association ($r^2 = .08$) is observed for PFOS and years worked in chemical and a stronger association ($r^2 = .23$) for PFHS. For chemical operators the strongest association ($r^2 = .34$) is with PFHS and years worked in chemical. Although the latter association was not observed among the engineer/lab category with the nontransformed variable (see Appendix E), the natural log transformation of PFHS was significantly associated ($r^2 = .19$) with years worked in chemical (see Appendix F).

Presented in Appendix G are similar scatterplots and regression models for all chemical participants by current job category. There remained a positive association between PFHS or PFOS serum levels and years worked in chemical, with the stronger of these two associations for PFHS. Because of more subjects, scatterplots are also now shown for cell operators. These plots suggest, again, an increase in PFOS, PFHS and now also POAA levels among current cell operators with years worked in chemical. Among chemical operators the strongest association remained with PFHS, with weaker linear associations observed for PFOS and POAA with years worked in chemical. Among the engineer/lab group, there remained a positive linear association between either PFHS or PFOS with years worked in chemical. There were positive linear associations for PFOS, PFHS and POAA with years worked in chemical among both the maintenance and supervisor/mgmt groups. Too few mill operators with 5 or more work years in chemical were sampled to conduct a meaningful analysis. The scatterplot data do show a wide range of serum POAA levels among mill operators with just one year of work experience in chemical.

The scatterplots in Appendix H represent the log transformations for all chemical participants and the two most numerous job categories: chemical operators and engineer/lab. Again, the scatterplots suggest a consistently strong positive association between serum PFHS levels and years worked in chemical and a lesser association with PFOS and years worked in chemical.

Presented earlier in Table 6 was the observation that serum fluorochemical levels were lower among female workers. Whether this was due to a smaller proportion of female workers in job categories where exposure would be the highest, younger female workers and/or female employees with less work experience in chemical remained to be resolved. To address this issue we focused on those two job categories that had the most female subjects within the random sample as well as all chemical participants: chemical operators and the engineer/lab group. Presented in Tables 22 and 23, by gender, are the demographic characteristics and serum fluorochemical levels for the random sample of chemical operators and the engineer/lab group. Female employees had significantly lower geometric mean serum levels of PFOS, PFHS and POAA. Multivariable analyses of chemical operators of each fluorochemical level regressed on gender, years worked in chemical and with and without age are presented in Appendix I for the random sample. For purposes of brevity, only the transformed (natural log) dependent models are presented. Gender appeared to be the best predictor of PFOS level (i.e., lower levels among female chemical operators) with years worked in chemical not significantly associated with PFOS. Gender was also significantly associated with POAA levels (lower POAA levels among female workers) adjusting for years worked in chemical and age. Both gender and years worked in chemical appeared to be important predictors of PFHS levels among chemical operators. Among the random sample of engineer/lab workers, gender was the most important predictor of PFOS, PFHS, POAA and PFOSAA levels after adjusting for years worked in chemical and age (Appendix [illegible]). Data for chemical operators and the engineer/lab group from the all chemical participants showed comparable results (Appendices K and L).

To further clarify this issue, regression analyses were stratified by gender as well as by job category. With male chemical operators as well as with the male engineer/lab group, there was a consistent association of increasing levels of PFOS and PFHS (and POAA for chemical operators only) with increasing years worked, at least for the first several years of work. Scatterplots are found in Appendix M. More questionable is whether such an association remains linear or is polynomial (quadratic) over time. Among female chemical operators the only association observed was for PFHS and years worked. Scatterplots are found in Appendix N. Neither PFOS or POAA levels appeared to increase with years worked in chemical among female chemical operators. The data for the female engineer/lab group are difficult to interpret since 6 of the 9 individuals had less than 5 years of work in chemical. Use of an interaction term (gender x years worked in chemical) in multivariable models was not an important predictor of fluorochemical levels.

Film Plant

Altogether there were 60 current employees who responded to the film plant random sampling. A total of 36 employees had worked only in the film plant (i.e., 'only in the film plant' refers to film plant workers with no known experience on the D-1 maker or have had no previous work experience in the chemical plant), 6 film plant employees were known to have worked on the D-1 maker and 18 employees had worked, at some time previously, in the chemical plant but were not on the D-1 maker (Table 24). For all film participants (n = 76, random sample and volunteers), a total of 49 had worked only in the film plant, 7 were known to have worked on the D-1 maker and 20 had worked, at some time previously, in the chemical plant.

Among the 60 employees of the random sample, there were no substantial demographic differences (Table 25) between the only film, the D-1 maker and prior chemical history groups. However, there were significant differences in serum fluorochemical levels among these three groups of film plant workers. Those employees who have only worked in the film plant (but not on D-1 maker or previous chemical plant history) had significantly lower mean PFOS levels (Table 26). The geometric mean of PFOS for only film plant workers was 0.110 ppm (95% CI 0.094-0.129) compared to 0.289 ppm (95% CI 0.159-0.527) for employees known to have worked on the D-1 maker and the geometric mean was 0.178 ppm (0.137-0.233) for film plant employees with prior history in chemical. A similar significant association, albeit at a lower ppm level, was observed for POAA. The only film plant employees had significantly lower PFHS levels when compared to film plant workers with a previous history in chemical; their PFHS levels were nonsignificantly lower than those who worked on the D-1 maker. There were no significant differences in sera levels of the remaining fluorochemical levels among the three groups of film employees. Interestingly, all film plant workers with a previous history of having worked in the chemical plant had M556 values that were below the LLOQ. We do note that the D-1 maker group had comparable levels of M570 to the only film or film with previous history in chemical groups (see Table 26). We had hypothesized the D-1 maker group may have had higher levels because of their use of methyl FOSE amide which may metabolize to the analyte M570 Provided in Table 27 are ratios of fluorochemicals. The median ratios were comparable for these groups of film plant workers in the random sample.

Restricting the analyses to film employees with no D-1 maker or chemical plant experience, there were no significant differences by age for the four current job categories analyzed: engineer/lab, film processor, maintenance and administrative (Table 28). Although their serum levels were substantially below their counterparts in chemical, maintenance employees working in the film plant had significantly higher PFOS, POAA and M570 levels than the engineer/lab group within the film plant (Table 29). Engineer/lab, film processors and administrative workers had comparable fluorochemical serum levels. Median fluorochemical ratios were comparable among these job categories of the random sample of film plant workers (Table 30). Similar findings were observed when all film plant participants were analyzed for demographics and serum fluorochemical levels (Tables 31-33).

Located in Appendix O are scatterplots of the only film group for each fluorochemical regressed on years worked in film. Because maintenance workers had higher levels, on average, than the other three job groups among the only film employees, they are numbered on the graphs. From these analyses there is some suggestion that PFOS and POAA levels may increase within the first few years of working at the Decatur film plant and then subsequently plateau. However, unlike chemical workers, there is no linear (or quadratic) association observed for PFHS. The remaining fluorochemicals showed no association with years worked in film.

DISCUSSION

The goal of this research effort was to quantify, based on random sampling, the relationship of employee serum levels of seven fluorochemicals at the Decatur chemical and film plants. In that regard, the data collected and analyzed present a convincing picture of significantly lower serum fluorochemical levels among employees who have only worked in the film plant when compared to those who are current chemical plant employees. For example, comparing the geometric means for each fluorochemical between chemical operators and those employees who only have worked in film, we observed the following ratios: PFOS (1.481/0.110); PFHS (0.428/0.015); POAA (1.887/0.052); PFOSAA (0.011/0.002); M570 (0.229/0.022); and M556 (0.044/0.003). These ratios, except for PFOSAA, suggest a 10-fold or greater difference between chemical operators and film plant employees who work several hundred yards away from Building 3. These only film plant workers appear to have a geometric mean value for PFOS that is approximately 3-4 times higher than the pooled geometric mean (0.029 ppm) from 64 samples obtained from 18 U.S. blood banks; thus, we suspect that occupational exposure to PFOS occurs within the film plant although at much lower levels than among employees working at the chemical plant.

Among film plant employees we also established the fact that workers on the D-1 maker have serum PFOS levels approximately 3 times higher than those who have never worked on the D-1 maker nor have worked in the chemical plant. Unexplained is the POAA levels of these workers on the D-1 maker as well as the levels observed among other film plant employees.

We confirmed several hypotheses for the chemical plant employees. First, cell operators have the highest serum levels of PFOS and PFHS although their serum levels for other fluorochemical analytes were similar to other chemical employees who were involved with the chemical reactors (i.e., chemical operators and maintenance workers). Second, chemical operators and maintenance workers had comparable serum fluorochemical levels. Besides their higher levels of PFOS and PFHS, they both had significantly higher levels of M570 (the methyl FOSE alcohol metabolite) and to a lesser degree to PFOSAA which is the ethyl FOSE alcohol metabolite (as well as an FC product itself, FC-129). Chemical operators, but not maintenance workers, had higher levels of PFOSA. Both chemical operators and maintenance workers had moderately higher levels of M556 than the other job categories. These data suggest that, beyond general plant-based environmental exposure to POSF and PHSF (which we assume is primarily through inhalation and conversion to PFOS and PFHS, respectively), the chemical operators and maintenance workers have higher serum levels as a result of their occupational exposure to the fluorochemical products. These occupational exposures may be from the FC alcohols, FC amides, and FC acrylates. Because these fluorochemicals have much lower vapor pressure than POSF and PHSF, these data may indicate that the exposure to these chemical products within the chemical plant is relatively limited to within Building 3 and Building 4N. Third, waste operators were comparable to chemical operators for serum levels of PFOS and PFHS but, like the cell operators, did not have higher levels of the fluorochemical analytes. Fourth, mill operators were generally much younger employees and their highest fluorochemical serum level was to POAA. Yet, the mill operators' POAA levels were lower than those of cell operators, chemical operators and maintenance workers. This suggests there is plant-based exposure of POAA well beyond the Building 4 area which may be due to the fact that POAA is a by-product of the electrolytic cell production. Finally, the data support the hypothesis that those individuals (e.g., engineers and secretaries) who are much less likely to have routine occupational exposure within the chemical plant, do, indeed have lower serum fluorochemical levels. Employees who have only worked in Building 1 which is immediately across the walkway from Building 3, have serum fluorochemical levels that range between 7 (PFOS, PFHS) and 15 times (PFOSAA) lower than employees who have only worked in Building 3.

Our analyses of fluorochemical levels in serum from randomly selected employees strengthen the recommendations that were recently made in a Decatur industrial hygiene assessment analysis [Logan, 1998]. There is a strong correlation between the higher employee serum levels in the present study and air, surface and personal monitoring measurements which occurred during the industrial hygiene assessment. In the industrial hygiene assessment, Building 3 had the highest average airborne total fluorochemical levels with each value derived from the total mass of detected target analytes in each sample (POSF, PHSF, FC amides, FC alcohols, FC acrylates) (see below):

Results of Fluorochemical Tube Air Samples

Bldg No.	No. Samples	Average*	Low*	High*
1	19	0.0145	0.000	0.0601
3	66	1.6884	0.0070	38.0583
4	10	0.1269	0.0047	0.5216
Outside air	3	0.0861	0.580	0.1247

*mg/m^3

Surface wipe sampling was also conducted throughout the chemical plant (Buildings 1, 2, 3, 4, 17, 38, 49, 51 and 57). Sample results indicated that fluorochemicals were found in nearly all samples with large variations in concentration. Building 3 had the highest surface fluorochemical contamination with the average surface concentration greater than 100 ug/100cm^2. Also, methyl FOSE alcohol was the largest contributor of fluorochemicals found throughout surface wipes in Building 3. Hand-wipe samplings indicated that employees who had washed their hands had very low levels of fluorochemicals detected. Methyl FOSE alcohol and POAA were the compounds found most often on employees' hands. Thus, the present study's sera fluorochemical levels, observed by job categories and building locations, strongly support the recommendations borne from industrial hygiene assessments. These recommendations include specific engineering controls to reduce inhalation exposure, appropriate personal protective equipment to prevent overexposure and appropriate personal hygiene practices among employees to remove skin concentrations.

For the first time we have shown a relationship between serum PFHS levels and the number of years worked in chemical. This finding was observed across various current job categories within chemical which suggests PHSF, due to its high vapor pressure, is likely present throughout the chemical plant premises. The pharmacokinetics of PFHS are unknown, although due to the shorter chain length, we suspect the biological half-life may be less than PFOS.

We observed only a modest association between years worked in the chemical plant and serum PFOS, and to a lesser extent POAA, levels. These associations appear to be more evident among employees within their first five years as demonstrated by significant quadratic associations found with both male chemical operators and engineers/laboratory personnel.

Like their male counterparts, female chemical operators appear to have increased PFHS levels with years worked. However, unlike their male counterparts, there was no apparent linear association between PFOS and years worked. Whether this is due to different work practices, exposure patterns or pharmacokinetics once absorbed, remains to be determined. Gender-related differences in the toxicokinetics of POAA have been reported for rats although the mechanism of excretion may be species dependent since these gender differences were not observed in mice, rabbits or dogs [Griffith and Long, 1980; Hanhijarvi and Ylinen, 1988]. The half-life of POAA was estimated to be 7 times higher (7 days) in male rats than female rats.

A limitation to this study design which must be considered in the interpretation of the data was our inability to more accurately quantify an employee's work history experience. Decatur work history records provide department numbers and job titles but they do not provide information regarding where someone worked (e.g., what building(s) or with what specific fluorochemicals). Self-reported work history information obtained by questionnaire was highly correlated with Decatur work history record information; nevertheless, the specificity of where someone worked and with what chemicals was not known. Because many operations are in batch mode, the likelihood of determining specificity of workload fluorochemical exposure among chemical operators is not possible. Furthermore, such records do not exist back in time. Nevertheless, with use of the employees current (or longest) job along with additional surrogate variable exposures (years worked in chemical, building number) we were able to compare and contrast fluorochemical levels. The least predictive of these three variables (job type, building and years worked) was years worked with the exception of PFHS where a strong linear association existed across job categories for PFHS with years worked.

We did not observe an association between hand-to-mouth usage or hand cleanliness (frequency of washing hands) and serum fluorochemical levels. It is possible an association might have been masked because industrial hygiene had instituted an aggressive educational campaign several months prior to the collection of blood samples in this study; thus, current practices may not be indicative of past practices. Because the half-life of PFOS is estimated to be 1000 days or more, such an association may not be discoverable with this study design.

The serum levels observed in this study for PFOS and POAA are not different than those that have been previously reported for this study and other 3M occupational populations [Olsen et al., 1998a, 1998b, 1999]. Olsen et al. [1999] have not associated hepatic or lipid abnormalities with PFOS levels in the Decatur and Antwerp plant populations that underwent voluntary medical surveillance in 1995 and 1997. Hepatic lipid or hormone levels have not been associated with serum POAA levels among 3M Cottage Grove male workers who have experienced higher serum fluorochemical levels than those determined in the present study for these Decatur employees [Gilliland and Mandel 1996; Olsen et al. 1998a; 1998b].

In summary, the objective of this proposed research study was to characterize, via random sampling, the distribution of employee serum levels of PFOS, PFHS, POAA, PFOSAA, M570, PFOSA and M556 at the 3M Decatur chemical and film plants. The data obtained from this exposure assessment investigation are important for several reasons. First, these data allow for a better understanding of the exposure distribution of serum fluorochemical levels in both the chemical and film plant employee populations. Second, these data may serve as future reference regarding human exposure assessment for the film as well as the chemical plant in the area of health studies and exposure reduction. Third, the data may be used for the construction of an exposure matrix for the anticipated update of the retrospective cohort mortality study of the Decatur employee population. Finally, this study will allow for the opportunity for employees to know their own serum levels for these seven fluorochemicals and encourage further practices leading to a reduction in their serum fluorochemical levels by the variety of exposure-reduction methods recommended in the Decatur industrial hygiene exposure assessment report [Logan, 1998].

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Table 1. Random sample selection by Decatur departments with percent participation

Dept Number	Dept Name	Total N	Sample Size	Participated (%) Yes	Participated (%) No
Employees with 090 location codes					
7613	3M/Dyneon Related Decatur	112	30	25 (83)	5 (17)
7620	Decatur Bldg 2 Operations	25	10	7 (70)	5 (30)
7621	Bldg 49 Operations	1			
7630	Decatur Bldg 3 Operations	113	30	25 (83)	5 (17)
7641	Decatur Bldg 4N Operations	60	15	13 (87)	2 (13)
7609	Decatur SMD Maint-SA&C	54	15	14 (93)	1 (7)
37	Mfg Servcices Process Eng	2	26	23 (88)	3 (12)
6825	Process Instrumentation & CN	1			
8038	Supply Chain Resource Unit	1			
7604	Decatur SMD Chem Factory Adm	4			
7605	Decatur SMD Chem Quality Ass	25			
7616	Decatur Chem Ship Rcv Whse	24			
7617	Decatur SMD Logistics	10			
7622	Decatur PCPD FF Admin	24			
5980	Decatur EHS&R	21	5	5 (100)	0 (0)
Employees regardless of 090 or 190 location					
6853	Auto & Chem Mkts Eng	8 (090)	5	4 (80)	1 (20)
6853	Auto & Chem Mkts Eng	6 (190)			
4290	Auto & Chem IT NPI/R&D	1 (190)			
4294	Auto & Chem IT Mfg – Quality/S	4 (190)			
4297	Auto & Chem IT CMG Mfg	6 (190)			
Waste water treatment employees					
5984	Decatur Waste Treatment	6	6	6 (100)	0 (0)

Table 1 (continued)

Dept Number	Dept Name	Total N	Sample Size	Participated (%) Yes	Participated (%) No
Heating plant employees					
5982	Decatur Heating Plant	10	4	3 (75)	1 (25)
Film plant employees					
	All remaining 190 location Department codes	482	78	55 (71)	23 (29)
Dyneon					
	Dyneon employees	25	8	6 (75)	2 (25)
TOTAL		1025	232	186 (80)	46 (20)

Table 2. Number (and percent) of random sample, volunteer and all participant chemical employees by demographic characteristics

	Sample (N = 126)		Volunteers (N = 61)		All Participants (N = 187)	
	N	(%)	N	(%)	N	(%)
Gender						
Female	24	(19)	9	(15)	33	(18)
Male	102	(81)	52	(85)	154	(82)
Only Worked In Chemical						
Yes	67	(53)	33	(54)	100	(53)
No	59	(47)	28	(46)	87	(47)
Current Job						
Cell Operator	5	(4)	4	(7)	9	(5)
Chemical Operator	47	(37)	17	(28)	64	(34)
Engineer/Lab	23	(18)	14	(23)	37	(20)
Maintenance	11	(9)	6	(10)	17	(9)
Mill Operator	13	(10)	11	(18)	24	(13)
Secretary	4	(3)	1	(2)	5	(3)
Supervisor/Mgmt	18	(14)	8	(13)	26	(14)
Waste Operator	5	(4)	0	(0)	5	(3)
Longest Job						
Cell Operator	1	(1)	2	(3)	3	(2)
Chemical Operator	57	(45)	20	(33)	77	(41)
Engineer/Lab	21	(17)	10	(16)	31	(17)
Film Processor	3	(2)	2	(3)	5	(3)
Maintenance	14	(11)	6	(10)	20	(11)
Mill Operator	14	(11)	12	(20)	26	(14)
Secretary	6	(5)	1	(2)	7	(4)
Supervisor/Mgmt	7	(6)	8	(13)	15	(8)
Waste Operator	3	(2)	0	(0)	3	(2)

Table 2. (continued)

	Sample (N = 126)		Volunteers (N = 16)		All Participants (N = 187)	
	N	(%)	N	(%)	N	(%)
Chew Gum						
Always/Frequently	22	(18)	14	(23)	36	(20)
Sometimes	32	(26)	20	(33)	52	(28)
Rarely/Never	70	(56)	26	(43)	96	(52)
Chew Tobacco						
Yes	19	(15)	6	(10)	25	(14)
No	105	(85)	54	(90)	159	(86)
Smoke Cigarettes						
Yes	41	(33)	14	(23)	55	(31)
No	82	(67)	46	(77)	128	(69)
Hand to Mouth Contact						
Yes	84	(68)	42	(70)	126	(68)
No	40	(32)	18	(30)	58	(32)
Wash Hands						
Yes	101	(81)	42	(70)	143	(78)
No	23	(19)	18	(30)	41	(22)

Table 3. Percentage of employees from the random sample, volunteers and all participants who responded that they currently work and ever worked in Decatur buildings/areas

Currently Work in Buildings…	Sample (N = 126) N	(%)	Volunteer (N = 61) N	(%)	All Participants (N = 187) N	(%)
1	42	(33)	22	(36)	64	(34)
2/49	22	(17)	16	(26)	38	(20)
3 OS	39	(31)	21	(34)	60	(32)
3 NOS	41	(33)	23	(38)	64	(34)
4 N	37	(29)	22	(36)	59	(32)
4 Mill/Extruder	45	(36)	29	(48)	74	(40)
17	18	(14)	10	(16)	28	(15)
38/51	24	(19)	21	(34)	45	(24)
42	15	(12)	14	(23)	29	(16)
61	23	(18)	14	(23)	37	(20)
Film	12	(10)	9	(15)	21	(11)
Wastewater	14	(11)	10	(16)	24	(13)

Ever Worked in Buildings…	Sample N	(%)	Volunteer N	(%)	All Participants N	(%)
1	52	(41)	25	(41)	77	(41)
2/49	33	(26)	14	(23)	47	(25)
3 OS	68	(54)	30	(49)	98	(52)
3 NOS	72	(57)	31	(51)	103	(55)
4 N	64	(51)	30	(49)	94	(50)
4 Mill/Extruder	80	(63)	43	(70)	123	(66)
17	22	(17)	9	(15)	17	(9)
38/51	36	(29)	21	(34)	57	(30)
42	29	(23)	18	(30)	47	(25)
61	25	(20)	12	(20)	37	(20)
Film	41	(33)	19	(31)	60	(32)
Wastewater	19	(15)	7	(11)	26	(14)

Table 4. Serum fluorochemical levels (ppm) of random sample, volunteers and all participant chemical employees

	Random Sample				Volunteers				All Participants			
	Mean	Geometric Mean	Median	Range	Mean	Geometric Mean	Median	Range	Mean	Geometric Mean	Median	Range
PFOS	1.505	0.941	1.140	0.091 - 10.600	1.259	0.758	0.877	0.052 – 4.940	1.424	0.877	0.994	0.052 – 10.600
PFHS	0.345	0.180	0.170	0.005 – 1.880	0.272	0.122	0.125	0.001 – 1.580	0.321	0.159	0.167	0.001 – 1.880
POAA	1.536	0.899	1.300	0.021 – 6.760	1.206	0.649	0.908	0.015 – 4.640	1.429	0.808	1.200	0.015 – 6.760
PFOSAA	0.023	0.008	0.008	0.001 – 0.269	0.026	0.007	0.006	0.001 – 0.234	0.024	0.008	0.008	0.001 – 0.269
M570	0.150	0.081	0.067	0.008 – 0.992	0.173	0.068	0.054	0.004 – 3.100	0.158	0.076	0.063	0.004 – 3.100
PFOSA	0.062	0.013[a]	0.012	0.0005 – 0.612	0.029	0.006	0.007	0.005 – 0.443	0.051	0.010	0.010	0.001 – 0.612
M556	0.052	0.022	0.026	0.001 – 0.406	0.041	0.020	0.018	0.003 – 0.329	0.048	0.022	0.023	0.001 – 0.406

a. significantly different ($p < .05$) geometric mean than volunteers, student's t test

Table 5. Demographic characteristics of current job categories of random sample (N = 126) of chemical employees

	Cell Operator^{a} (N = 5)	Chemical Operator^{b} (N = 47)	Engineer/ Lab^{c} (N = 23)	Maintenance^{d} (N = 11)	Mill Operator^{e} (N = 13)	Secretary^{f} (N = 4)	Supervisor/ Mgmt^{g} (N = 18)	Waste Operator^{h} (N = 5)
Age								
Mean	45^{e}	42^{e,g,h}	41^{g,h}	41^{g,h}	35^{a,b,f,g,h}	45^{e}	47^{b,c,d,e}	50^{b,c,d,e}
SE (standard error)	1.2	1.2	1.7	2.5	2.3	4.2	2.0	3.7
Median	44	43	42	42	34	45	45	50
Range	40 – 50	25 – 62	23 – 58	27 – 52	27 – 45	42 – 49	41 – 57	49 – 52
BMI								
Mean	25.8	28.3^{f}	27.6	26.9	27.7	22.4^{b,g}	29.5^{f}	25.5
SE	1.5	5.1	5.0	2.8	5.4	2.0	6.1	3.2
Median	25.0	27.8	27.6	26.6	27.3	22.0	27.6	25.8
Range	22.1 - 30.0	20.2 – 47.5	18.5 – 38.4	22.8 – 32.5	19.6 – 42.0	20.9 – 25.1	21.8 – 47.3	21.8 – 30.1
Years Worked In Chemical								
Mean	23^{b,d,e}	11^{a,e,g}	15^{e}	9^{a,g}	3^{a,b,c,f,g,h}	15^{e}	20^{b,d,e}	14^{e}
SE	2.0	1.4	2.8	3.0	1.5	4.9	2.5	4.5
Median	24	10	15	4	1	18	24	16
Range	17 – 29	1 – 31	1 – 37	1 – 26	1 – 21	2 - 25	1 – 36	1 – 27
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Gender*								
Female	1 (20)	10 (21)	6 (26)	0 (0)	1 (8)	4 (0)	2 (11)	0 (0)
Male	4 (80)	37 (79)	17 (74)	11 (100)	12 (92)	0 (0)	16 (89)	5 (100)
Only Worked In* Chemical								
Yes	3 (60)	23 (49)	14 (61)	6 (55)	11 (85)	1 (25)	9 (50)	0 (0)
No	2 (40)	24 (51	9 (39)	5 (45)	2 (15)	3 (75)	9 (50)	5 (100)
Hand to Mouth Contact								
Yes	3 (60)	35 (76	11 (50)	8 (73)	10 (77)	2 (50)	12 (67)	3 (60)
No	2 (40)	11 (24)	11 (50)	3 (27)	3 (23)	2 (50)	6 (33)	2 (40)
Wash Hands								
Always	5 (100)	40 (87)	16 (73)	10 (91)	12 (92)	2 (50)	13 (72)	3 (60)
Less frequently	0 (0)	6 (13)	6 (27)	1 (9)	1 (8)	2 (50)	5 (28)	2 (40)

*Current job types significantly different, p < .05 chi square statistic
(a-h) comparison for each current job category using student's t (p < .05)

Table 6. Mean, geometric mean and median of serum fluorochemicals by demographic characteristics of random sample (N = 126) of chemical employees

	PFOS			PFHS			POAA		
	Mean	Geometric Mean	Median	Mean	Geometric Mean	Median	Mean	Geometric Mean	Median
Gender									
Female	0.686	0.459	0.412	0.118	0.080	0.082	0.691	0.326	0.245
Male	1.697	0.897*	1.310	0.398	0.218*	0.223	1.735	1.142*	1.000
Hand To mouth									
Yes	1.362	1.008	1.140	0.278	0.173	0.168	1.504	0.963	1.355
No	1.810	0.674	0.954	0.474	0.185	0.181	1.602	0.637	1.210
Wash hands									
Yes	1.581	0.897	1.190	0.360	0.188	0.176	1.597	0.978	1.300
No	1.179	0.459	0.735	0.259	0.136	0.126	1.263	0.731	1.300
Worked only in chemicai									
Yes	1.113	0.723	0.784	0.247	0.126	0.141	1.307	0.729	1.060
No	1.927	1.271	1.550	0.456	0.270*	0.306	1.797	1.142*	1.590

Table 6. (continued)

	PFOSAA			M570			PFOSA			M556		
	Mean	Geometric Mean	Median	Mean	Geometric Mean	Median	Mean	Geometric Mean	Median	Mean	Geometric Mean	Median
Gender												
Female	0.011	0.003	0.002	0.077	0.053	0.052	0.037	0.012	0.014	0.025	0.014	0.013
Male	0.026	0.010	0.009	0.168	0.089*	0.073	0.068	0.013	0.011	0.058	0.025	0.028
Hand To Mouth												
Yes	0.026	0.009	0.008	0.153	0.085	0.637	0.050	0.012	0.012	0.054	0.022	0.021
No	0.019	0.007	0.008	0.139	0.079	0.081	0.080	0.013	0.011	0.048	0.026	0.030
Wash hands												
Yes	0.025	0.009	0.009	0.162	0.088	0.672	0.063	0.013	0.013	0.059	0.026*	0.028
No	0.017	0.005	0.003	0.893	0.055	0.632	0.045	0.009	0.009	0.020	0.012	0.015
Worked only in chemical												
Yes	0.024	0.009	0.008	0.142	0.075	0.063	0.059	0.012	0.013	0.046	0.019	0.019
No	0.022	0.008	0.008	0.160	0.088	0.074	0.065	0.014	0.011	0.058	0.027	0.030

* t test, $p < .05$

Table 7. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemical levels by current job categories among random sample (N = 126) of chemical employees

	Cell Operator[a] (N = 5)	Chemical Operator[b] (N = 47)	Engineer/ Lab[c] (N = 23)	Maintenance[d] (N = 11)	Mill Operator[e] (N = 13)	Secretary[f] (N = 4)	Supervisor/ Mgmt[g] (N = 18)	Waste Operator[h] (N = 5)
PFOS								
Mean	2.903	1.781	0.634	1.672	0.718	0.497	1.879	2.649
Range	0.325 – 6.840	0.471 – 7.260	0.095 – 1.740	0.291 – 4.060	0.230 – 2.040	0.220 – 1.140	0.091 – 10.600	0.254 – 7.880
G. Mean	1.970[c,e,f]	1.481[c,e,g,h]	0.391[a,b,d,g,h]	1.299[c,e,f]	0.589[a,b,d,h]	0.397[a,b,d,h]	0.885[c]	1.504[c,e,f]
95% C.I.	0.732 – 5.304	1.250 – 1.755	0.256 – 0.597	0.822 – 2.054	0.419 – 0.828	0.195 – 0.807	0.480 – 1.630	0.493 – 4.589
PFHS								
Mean	1.062	0.428	0.171	0.237	0.109	0.082	0.419	0.444
Range	0.083 – 1.880	0.071 – 1.860	0.005 – 0.905	0.023 – 0.790	0.028 – 0.374	0.027 – 0.172	0.010 – 1.420	0.038 – 1.210
G. Mean	0.697[c,d,e,f,g]	0.308[c,e,f]	0.078[a,b,g,h]	0.153[a]	0.074[a,b,g,h]	0.066[a,b,g]	0.215[c,e,f]	0.232[c,e]
95% C.I.	0.228 – 2.130	0.246 – 0.386	0.046 – 0.134	0.084 – 0.280	0.047 – 0.116	0.031 – 0.140	0.115 – 0.402	0.069 – 0.775
POAA								
Mean	2.213	2.252	0.376	1.483	1.383	0.183	1.371	1.663
Range	0.126 – 3.640	0.150 – 6.760	0.035 – 2.320	0.211 – 4.680	0.450 – 2.340	0.095 – 2.611	0.021 – 4.540	0.936 – 2.710
G. Mean	1.428[c,f]	1.887[c,f,g]	0.208[a,b,d,e,f,g,h]	1.095[c,f]	1.266[c,f,g]	0.172[a,b,d,e,g,h]	0.637[b,c,e,f]	1.542[c,f]
95% C.I.	0.422 – 4.833	1.573 – 2.265	0.134 – 0.324	0.670 – 1.791	0.985 – 1.629	0.113 – 0.260	0.310 – 1.308	1.052 – 2.259
PFOSAA								
Mean	0.006	0.036	0.014	0.034	0.020	0.002	0.011	0.009
Range	0.001 – 0.016	0.001 – 0.269	0.001 – 0.073	0.001 – 0.083	0.004 – 0.038	0.001 – 0.004	0.001 – 0.054	0.003 – 0.017
G. Mean	0.003[b,d,e]	0.011[a,c,f]	0.005[b,d,e]	0.017[illegible]	0.015[illegible]	0.002[illegible]	0.006	0.006
95% C.I.	0.001 – 0.009	0.007 – 0.018	0.003 – 0.010	0.007 – 0.043	0.010 – 0.024	0.001 – 0.003	0.003 – 0.010	0.003 – 0.013
M570								
Mean	0.035	0.229	0.074	0.268	0.045	0.039	0.122	0.087
Range	0.024 – 0.056	0.009 – 0.992	0.008 – 0.410	0.038 – 0.701	0.025 – 0.115	0.010 – 0.072	0.010 – 0.553	0.050 – 0.159
G. Mean	0.033[b,d]	0.131[a,c,e,f,g]	0.049[b,d]	0.204[a,c,e,f,g]	0.042[b,d]	0.030[b,d]	0.064[b,d]	0.079
95% C.I.	0.024 – 0.045	0.094 – 0.182	0.034 – 0.071	0.124 – 0.335	0.034 – 0.051	0.013 – 0.071	0.037 – 0.111	0.052 – 0.121

Table 7. (continued)

PFOSA								
Mean	0.003	0.099	0.017	0.065	0.040	0.031	0.065	0.0381
Range	0.001 – 0.011	0.001 – 0.487	0.001 – 0.063	0.001 – 0.569	0.012 – 0.204	0.009 – 0.080	0.001 – 0.612	0.002 – 0.161
G. Mean	0.002[b,e]	0.028[a,c,d,g]	0.005[b,e]	0.009[b]	0.026[a,c]	0.021	0.007[b]	0.012
95% C.I.	0.001 – 0.005	0.017 – 0.048	0.002 – 0.010	0.003 - 0.025	0.016 – 0.040	0.009 – 0.054	0.003 – 0.020	0.003 – 0.048
M556								
Mean	0.014	0.074	0.019	0.115	0.013	0.015	0.046	0.047
Range	0.003 – 0.028	0.001 – 0.380	0.002 – 0.127	0.016 – 0.406	0.002 – 0.045	0.003 – 0.030	0.003 – 0.336	0.013 – 0.157
G. Mean	0.011[b,d]	0.044[a,c,e,f,g]	0.010[b,d]	0.074[a,c,e,f,g]	0.009[b,d]	0.010[b,d]	0.015[b,d]	0.027
95% C.I.	0.005 – 0.218	0.032 – 0.061	0.006 – 0.015	0.041 – 0.135	0.006 – 0.015	0.003 – 0.031	0.007 – 0.030	0.011 – 0.068

(a-h) comparisons for each current job category using student's t, $p < 0.5$

Table 8. Fluorochemical ratios by current job categories for random sample (N = 126) of chemical employees

	Cell Operator[a] (N = 5)	Chemical Operator[b] (N = 47)	Engineer/ Lab[c] (N = 23)	Maintenance[d] (N = 11)	Mill Operator[e] (N = 13)	Secretary[f] (N = 4)	Supervisor/ Mgmt[g] (N = 18)	Waste Operator[h] (N = 5)
PFOS/PFHS								
Mean	3.0[d,e,h]	5.5[d,e]	5.9[d,e]	9.2[a,b,c,g]	8.5[a,b,g,h]	6.1	5.0[d,e]	7.1[a]
Median	3.3	5.2	5.2	10.3	8.3	5.8	3.3	6.6
Range	1.5 – 3.9	1.1 – 14.8	1.6 – 18.8	3.7 – 16.5	4.3 – 14.9	4.8 – 8.3	1.9 – 11.7	3.2 – 12.3
PFOS/POAA								
Mean	1.5[e]	0.9[c,f,g]	2.2[b,d,e]	1.2[c,e,f]	0.5[a,c,f,g]	2.5[b,d,e,h]	1.8[b,e]	1.4[f]
Median	1.0	0.9	1.7	1.3	0.5	2.0	1.6	1.0
Range	1.0 – 2.6	0.3 – 3.1	0.7 – 4.4	0.7 – 1.5	0.2 – 0.9	1.7 – 4.4	0.3 – 4.8	0.3 – 2.9
PFOS/Analytes								
Mean	52.6[b-h]	7.4[a,h]	7.4[a,h]	4.6[a,h]	6.7[a]	6.7[a]	16.7[a]	26.5[a-e]
Median	56.1	4.7	3.9	3.2	4.8	6.9	6.7	9.8
Range	4.9 – 93.3	1.3 – 61.8	0.8 – 36.8	1.4 – 11.7	2.5 – 20.5	3.2 – 9.7	1.3 – 134.2	0.8 – 99.4
M570/M556								
Mean	3.5	3.7[c,e]	5.8[b]	3.3[c,e]	5.8[b,d]	3.2	5.3	3.3
Median	2.8	3.0	5.7	2.7	4.3	3.2	4.2	3.4
Range	2.0 – 7.5	0.5 – 8.9	1.9 – 14.4	1.2 – 8.7	1.2 – 21.3	2.2 – 4.3	1.6 – 9.5	1.0 – 5.3
PFOSAA/M556								
Mean	0.4[e]	0.9[e]	1.1[e]	0.8[e]	2.4[a-d,f-h]	0.2[e]	1.1[e]	0.4[e]
Median	0.3	0.2	0.8	0.1	2.3	0.2	0.5	0.3
Range	0.1 – 1.3	0.03 – 8.5	0.03 – 4.5	0.01 – 3.1	0.2 – 5.7	0.05 – 0.5	0.02 – 4.8	0.1 – 1.1
PFOSA/M556								
Mean	0.4	3.0	2.5	0.4[e]	7.6[d]	2.5	4.7	2.6
Median	0.1	0.3	0.3	0.1	2.1	2.7	0.3	0.3
Range	0.04 – 1.2	0.03 – 30.7	0.03 – 18.3	0.02 – 2.7	0.8 – 52.3	0.9 – 3.7	0.02 – 64.1	0.03 – 11.8

Table 9. Demographic characteristics of longest job categories of random sample (N = 126) of chemical employees

	Chemical Operator[a] (N = 57)		Engineer/ Lab[b] (N = 21)		Maintenance[c] (N = 14)		Mill Operator[d] (N = 14)		Secretary[e] (N = 6)		Supervisor/ Mgmt.[f] (N = 7)		Waste Operator[g] (N = 3)	
Age														
Mean	43		40		43		35		46^{d}		49^{b,d}		53^{b,d}	
SE	1.1		2.3		1.9		1.8		1.9		2.1		2.3	
Median	44		41		43		32		45		50		52	
Range	25 – 62		23 – 58		27 – 54		27 – 45		42 - 54		42 - 56		49 – 57	
BMI														
Mean	27.8		28.8		27.2		27.3		24.2		29.4		26.9	
SE	0.7		1.1		0.7		1.4		1.4		3.5		2.4	
Median	27.5		28.0		26.7		26.9		23.9		25.9		25.8	
Range	18 – 47		21 – 38		23 – 33		20 - 42		21 – 30		18 – 47		23 – 32	
Years Worked In Chemical														
Mean	14^{d}		12^{d}		11		3^{a,b}		20^{d}		20.2^{d}		11.0	
SE	1.3		2.7		3.0		1.4		4.4		5.5		6.8	
Median	14		8		8		1		23		23		8	
Range	1 – 31		1 – 37		1 – 36		1 – 21		2 - 33		1 - 37		1 – 24	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Gender														
Female	8	(14)	5	(24)	0	(0)	2	(14)	6	(100)	2	(28)	0	(0)
Male	49	(86)	16	(76)	14	(100)	12	(86)	0	(0)	5	(72)	3	(100)
Only Worked In Chemical*														
Yes	27	(47)	15	(71)	6	(43)	12	(86)	3	(50)	4	(57)	0	(0)
No	30	(53)	6	(29)	8	(57)	2	(14)	3	(50)	3	(43)	3	(100)
Hand to Mouth Contact														
Yes	39	(70)	11	(52)	9	(64)	11	(79)	3	(50)	5	(72)	3	(100)
No	17	(30)	10	(48)	5	(36)	3	(21)	3	(50)	2	(28)	0	(0)
Wash Hands														
Yes	47	(84)	15	(71)	86	(12)	93	(13)	3	(50)	6	(86)	2	(67)
No	9	(16)	6	(29)	2	(14)	1	(7)	3	(50)	1	(14)	1	(33)

*Significantly different percentage among longest job categories, chi square, $p < .05$
(a-h) comparisons for each longest job category using student's t, $p < .05$

Table 10. Mean, median, geometric mean and 95% confidence intervals of geometric mean of serum fluorochemical levels by longest job categories among random sample (N = 126) of chemical employees

	Chemical Operator[a] (N = 57)	Engineer/ Lab[b] (N = 21)	Maintenance[c] (N = 14)	Mill Operator[d] (N = 14)	Secretary[e] (N = 6)	Supervisor/ Mgmt[f] (N = 7)	Waste Operator[g] (N = 3)
PFOS							
Mean	2.088	0.520	2.250	0.735	0.388	0.536	2.388
Range	0.338 – 7.880	0.095 – 1.740	0.291 – 10.600	0.230 – 2.040	0.129 – 1.140	0.091 – 1.220	0.254 – 4.840
G. Mean	1.697[b,d,e,f]	0.330[a,c,d,g]	1.490[b,d,e,f]	0.609[a,c,f]	0.295[a,c,g]	0.400[a,c,g]	1.365[b,e,f]
95% C.I.	1.440 – 1.998	0.219 – 0.496	0.933 – 2.379	0.441 – 0.842	0.163 – 0.533	0.209 – 0.764	0.245 – 7.600
PFHS							
Mean	0.543	0.116	0.297	0.107	0.070	0.128	0.256
Range	0.073 – 1.880	0.005 – 0.420	0.023 – 1.250	0.028 – 3.744	0.027 – 0.172	0.010 – 0.383	0.0388 – 0.562
G. Mean	0.388[b,c,d,e,f,]	0.067[a,c]	0.176[a,b,d,e]	0.074[a,c]	0.057[a,c]	0.077[a]	0.153
95% C.I.	0.314 – 0.480	0.041 – 0.110	0.101 – 0.307	0.048 – 0.112	0.033 – 0.097	0.030 – 0.193	0.033 – 0.703
POAA							
Mean	2.293	0.287	1.667	1.383	0.143	0.407	2.219
Range	0.182 – 6.760	0.035 – 1.000	0.211 – 4.680	0.450 – 2.340	0.053 – 0.261	0.021 – 1.790	0.936 – 3.680
G. Mean	1.972[b,c,e,f]	0.198[a,c,d,g]	1.229[a,b,e,f]	1.274[b,e,f]	0.124[a,c,d,g]	0.177[a,c,d,g]	1.915[b,e,f]
95% C.I.	1.694 – 2.295	0.134 – 0.295	0.797 – 1.900	1.009 – 1.609	0.076 – 0.203	0.062 – 0.510	0.881 – 4.166
PFOSAA							
Mean	0.032	0.014	0.029	0.019	0.002	0.011	0.008
Range	0.001 – 0.269	0.001 – 0.073	0.001 – 0.083	0.004 – 0.038	0.001 – 0.004	0.001 – 0.019	0.003 – 0.016
G. Mean	0.010[b,e]	0.005[a,c,d]	0.014[b,e]	0.014[b,e]	0.001[a,c,d,f,g]	0.008[e]	0.006
95% C.I.	0.007 – 0.016	0.027 – 0.010	0.007 – 0.031	0.009 – 0.022	0.001 – 0.002	0.004 – 0.017	0.002 – 0.016
M570							
Mean	0.213	0.060	0.269	0.046	0.032	0.071	0.104
Range	0.009 – 0.992	0.008 – 0.164	0.038 – 0.701	0.025 – 0.115	0.010 – 0.072	0.016 – 0.201	0.053 – 0.159
G. Mean	0.120[b,d,e,f]	0.046[a,c]	0.200[b,d,e,f]	0.043[a,c]	0.025[a,c]	0.054[a,c]	0.095
95% C.I.	0.089 – 0.161	0.033 – 0.064	0.126 – 0.315	0.035 – 0.052	0.014 – 0.046	0.030 – 0.096	0.050 – 0.177

Table 10. (continued)

PFOSA							
Mean	0.088	0.016	0.095	0.042	0.024	0.027	0.014
Range	0.001 – 0.487	0.001 – 0.063	0.001 – 0.612	0.012 – 0.204	0.009 – 0.080	0.001 – 0.173	0.005 – 0.027
G. Mean	0.021[b,f]	0.004[a,d]	0.010	0.028[b,f]	0.017[f]	0.002[a,d,e]	0.012
95% C.I.	0.0126 – 0.0340	0.002 – 0.009	0.003 – 0.028	0.018 – 0.044	0.009 – 0.033	0.004 – 0.012	0.005 – 0.029
M556							
Mean	0.070	0.014	0.117	0.013	0.011	0.019	0.067
Range	0.001 – 0.380	0.002 – 0.039	0.015 – 0.406	0.002 – 0.045	0.003 – 0.030	0.003 – 0.059	0.001 – 0.157
G. Mean	0.039[b,d,e,f]	0.009[a,c,e,f,g]	0.069[b,d,c,f]	0.010[a,c]	0.007[a,c,g]	0.011[a,d]	0.037[b,e]
95% C.I.	0.029 – 0.054	0.006 – 0.014	0.038 – 0.123	0.006 – 0.015	0.003 – 0.017	0.004 – 0.027	0.008 – 0.180

(a-h) comparisons for each current job category using student's t, $p < .05$

Table 11. Ratio of fluorochemical levels by longest job categories among random sample (N = 126) of chemical employees

	Chemical Operator[a] (N = 57)	Engineer/ Lab[b] (N = 21)	Maintenance[c] (N = 14)	Mill Operator[d] (N = 14)	Secretary[e] (N = 6)	Supervisor/ Mgmt[f] (N = 7)	Waste Operator[g] (N = 3)
PFOS/PFHS							
Mean	5.0[c,d,g]	5.8[c,d]	9.1[a,b,e,f]	8.8[a,b,e,f]	5.6[c,d]	6.0	9.2[a]
Median	4.9	4.8	9.2	8.3	5.8	3.9	8.6
Range	1.1 – 14.8	1.9 – 18.8	3.7 – 16.5	4.3 – 14.9	2.2 – 8.3	3.0 – 11.7	6.6 – 12.3
PFOS/POAA							
Mean	1.0[b,e,f]	2.0[a,c,d,f,g]	1.3[b,d,e,f]	0.5[b,c,e,f]	2.6[a,c,g]	2.6[a,b,c,d,g]	0.9[b,e,f]
Median	0.9	1.7	1.3	0.5	2.0	52.6	1.0
Range	0.3 – 2.9	0.3 – 4.4	0.6 – 2.3	0.2 – 0.9	1.6 – 4.4	0.7 – 4.8	0.3 – 1.3
PFOS/Analytes							
Mean	13.4	5.9	5.3	6.6	6.0	5.5	22.2
Median	5.4	3.9	3.8	4.8	5.5	3.3	13.9
Range	1.3 – 99.4	0.8 – 16.8	1.4 – 11.7	2.5 – 20.5	3.2 – 9.7	1.3 – 17.8	0.8 – 51.9
M570/M556							
Mean	3.8[b,f]	5.7[a,c]	3.5[b,f]	5.6	3.7	6.4[a,c]	3.2
Median	3.0	4.5	3.1	4.2	3.9	3.4	3.0
Range	0.5 – 9.5	1.9 – 14.4	1.2 – 8.7	1.2 – 21.3	2.2 – 5.8	2.5 – 19.5	1.0 – 5.5
PFOSAA/M556							
Mean	0.9[d]	1.1[d]	0.7[d]	2.3[a,b,c,e,g]	0.2[d]	1.4	0.2[d]
Median	0.2	0.6	0.1	2.2	0.2	1.2	0.1
Range	0.03 – 8.5	0.04 – 4.5	0.01 – 3.1	0.2 – 5.7	0.05 – 0.5	0.02 – 3.7	0.1 – 0.5
PFOSA/M556							
Mean	2.6[f]	2.2	0.5[d,f]	7.4[c]	2.6	9.2[a,c]	1.1
Median	0.3	0.3	0.1	2.1	2.7	0.1	0.3
Range	0.03 – 30.7	0.03 – 18.3	0.02 – 2.7	0.8 – 52.3	0.9 – 3.7	0.02 – 64.1	0.03 – 2.8

(a-g) comparisons for each longest job category using student's t, p < .05

Table 12. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals among random sample (N = 126) of chemical employees who currently only work in certain buildings (as listed)

	Bldg. 1 (N=15)	Bldgs. 2/49 (N=7)	Bldg. 3 (N=22)	Bldg. 4MX (N=21)	Bldg. 4N (N=5)	Waste water (N=4)
PFOS						
Mean	0.768	2.621	2.457	0.607	2.000	2.763
Range	0.109 – 2.190	0.325 – 6.840	0.885 – 7.260	0.23 – 1.620	1.440 - 2670	0.254 – 7.880
G. Mean	0.481	1.945	2.135	0.525	1.937	1.369
95% C.I.	0.270 – 0.858	0.824 – 4.592	1.693 – 2.693	0.364 – 0.757	1.378 – 2.723	0.136 – 13.741
PFHS						
Mean	0.228	0.996	0.568	0.101	0.450	0.386
Range	0.013 – 0.713	0.083 – 1.880	0.151 – 1.860	0.028 – 0.374	0.161 – 0.832	0.038 – 1.210
G. Mean	0.115	0.709	0.410	0.069	0.397	0.177
95% C.I.	0.057 – 0.234	0.262 – 1.922	0.286 – 0.586	0.039 – 0.121	0.192 – 0.821	0.018 – 1.729
POAA						
Mean	0.554	1.879	2.777	1.303	2.088	1.804
Range	0.051 – 2.700	0.126 – 3.640	0.261 – 6.760	0.450 – 2.110	1.300 – 2.860	0.936 – 2.710
G. Mean	0.240	1.251	2.128	1.188	2.024	1.677
95% C.I.	0.119 – 0.487	0.412 – 3.802	1.467 – 3.087	0.865 – 1.631	1.420 – 2.886	0.815 – 3.452
PFOSAA						
Mean	0.013	0.005	0.055	0.019	0.019	0.010
Range	0.001 – 0.054	0.001 – 0.016	0.003 – 0.269	0.002 – 0.038	0.004 – 0.043	0.003 – 0.017
G. Mean	0.004	0.003	0.023	0.014	0.011	0.007
95% C.I.	0.002 – 0.010	0.001 – 0.008	0.012 – 0.043	0.007 – 0.026	0.003 – 0.048	0.002 – 0.031
M570						
Mean	0.101	0.028	0.382	0.037	0.099	0.091
Range	0.015 – 0.410	0.010 – 0.056	0.063 – 0.992	0.025 – 0.053	0.054 – 0.205	0.050 – 0.159
G. Mean	0.071	0.023	0.308	0.036	0.088	0.081
95% C.I.	0.044 – 0.115	0.013 – 0.043	0.224 – 0.423	0.031 – 0.043	0.047 – 0.165	0.034 – 0.195

Table 12. (continued)

PFOSA						
Mean	0.026	0.003	0.102	0.042	0.251	0.007
Range	0.005 – 0.161	0.005 – 0.106	0.003 – 0.569	0.012 – 0.204	0.003 – 0.487	0.002 – 0.011
G. Mean	0.009	0.002	0.036	0.027	0.059	0.006
95% C.I.	0.004 – 0.022	0.001 – 0.005	0.018 – 0.072	0.015 - 0.047	0.002 – 1.595	0.002– 0.019
M556						
Mean	0.027	0.012	0.119	0.008	0.076	0.056
Range	0.003 – 0.127	0.003 – 0.028	0.024 – 0.380	0.016 – 0.018	0.026 – 0.175	0.015 – 0.157
G. Mean	0.017	0.009	0.092	0.007	0.056	0.033
95% C.I.	0.010 – 0.030	0.004 – 0.021	0.066 – 0.129	0.005 – 0.011	0.019 – 0.163	0.006 – 0.193
Years in chemical						
Mean	20	24	10	5	13	13

Table 13. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals for those employees in random sample (N = 126) who said they have only worked in one building/area

	Bldg. 1 (N=6)	Bldg. 3 (N=7)	Bldg. 4MX (N=8)
PFOS			
Mean	0.474	2.561	0.521
Range	0.129 – 1.700	1.450 – 5.120	0.230 – 0.838
G. Mean	0.302	2.293	0.554
95% C.I.	0.114 – 0.797	1.453 – 3.619	0.340 – 0.904
PFHS			
Mean	0.117	0.835	0.063
Range	0.013 – 0.420	0.151 – 1.860	0.038 – 0.152
G. Mean	0.064	0.519	0.064
95% C.I.	0.018 – 0.223	0.185 – 1.450	0.039 – 0.103
POAA			
Mean	0.164	3.021	1.082
Range	0.053 – 0.386	0.366 – 6.760	0.450 – 1.850
G. Mean	0.125	2.033	1.030
95% C.I.	0.053 – 0.294	0.773 – 5.351	0.719 – 1.476
PFOSAA			
Mean	0.001	0.030	0.020
Range	0.001 – 0.003	0.005 – 0.118	0.008 – 0.037
G. Mean	0.001	0.016	0.015
95% C.I.	0.001 – 0.002	0.005 – 0.047	0.008 – 0.027
M570			
Mean	0.082	0.318	0.040
Range	0.015 – 0.201	0.063 – 0.480	0.026 – 0.053
G. Mean	0.053	0.274	0.048
95% C.I.	0.018 – 0.159	0.145 – 0.520	0.028 – 0.081
PFOSA			
Mean	0.023	0.158	0.043
Range	0.009 – 0.060	0.003 – 0.569	0.001 – 0.204
G. Mean	0.019	0.055	0.034
95% C.I.	0.009 – 0.037	0.009 – 0.324	0.011 - 0.108
M556			
Mean	0.022	0.097	0.010
Range	0.003 – 0.585	0.033 – 0.213	0.004 – 0.019
G. Mean	0.014	0.079	0.013
95% C.I.	0.004 – 0.045	0.042 – 0.150	0.005 – 0.034
Years in chemical			
Mean	23	15	1.6

Table 14. Age, BMI and years worked in chemical among current job categories of all participants (N = 187) in chemical

	Cell Operator[a] (N = 9)	Chemical Operator[b] (N = 64)	Engineer/ Lab[c] (N = 37)	Maintenance[d] (N = 17)	Mill Operator[e] (N = 24)	Secretary[f] (N = 5)	Supervisor/ Mgmt[g] (N = 26)	Waste Operator[h] (N = 5)
Age								
Mean	45[e]	41[e,g,h]	42[e,g,h]	41[e,g,h]	34[a,b,c,d,f,g,h]	44[e]	48[b,c,d,e]	50[b,c,d,e]
SE	2.1	1.2	1.8	1.5	1.3	1.3	1.2	0.7
Median	44	41	43	42	32	44	49	50
Range	38 – 59	25 – 62	23 – 58	27 – 52	25 – 45	42 – 49	33 – 59	49 – 52
BMI								
Mean	25.8	28.3[e]	27.3	27.6	28.1[e]	22.7[b,e,g]	28.9[e]	25.5
SE	1.3	0.7	0.9	0.8	1.1	0.8	1.1	1.4
Median	27.6	27.8	27.3	26.6	26.9	23.0	27.6	25.8
Range	18 – 30	19 – 47	16 – 38	23 – 33	20 – 43	21 – 25	18 – 47	21.8 – 30.1
Years Worked In Chemical								
Mean	19[b,d,e]	10[a,c,e,g]	15[b,e,g]	10[a,e,g]	2[a,b,c,d,f,g,h]	16[e]	21[b,d,e]	14[e]
SE	3.2	1.1	2.2	2.6	0.8	3.9	2.1	4.5
Median	21	10	14	3	1	20	24	16
Range	2 – 30	1 – 31	1 – 37	1 – 30	1 – 21	2 - 25	1 – 36	1 – 27

(a - h) comparisons for each current job category using student's t, $p < .05$

Table 15. Number (and percentage) of demographic characteristics among current job categories of all participants (N = 187) in chemical

	Cell Operator (N=9)	Chemical Operator (N=64)	Engineer/ Lab (N=37)	Maintenance (N=17)	Mill Operator (N=24)	Secretary (N=5)	Supervisor/ Mgmt (N=26)	Waste Operator (N=5)
Gender*								
Female	1 (11)	12 (19)	9 (24)	0 (0)	3 (13)	5 (100)	3 (12)	0 (0)
Male	8 (89)	52 (81)	28 (76)	17 (100)	21 (87)	0 (0)	23 (88)	5 (100)
Only Worked in Chemical*								
Yes	5 (55)	30 (47)	22 (60)	10 (59)	22 (92)	1 (20)	10 (38)	0 (0)
No	4 (45)	34 (53)	15 (40)	7 (41)	2 (8)	4 (80)	16 (62)	5 (100)
Hand to Mouth Contact								
Yes	7 (78)	48 (77)	16 (44)	13 (76)	21 (88)	3 (60)	15 (58)	3 (60)
No	2 (22)	14 (23)	20 (56)	4 (24)	3 (13)	2 (40)	11 (42)	2 (40)
Wash Hands								
Always	8 (89)	53 (85)	23 (64)	15 (88)	20 (83)	3 (60)	18 (69)	3 (60)
Less frequently	1 (11)	9 (15)	13 (36)	2 (12)	4 (17)	2 (40)	8 (31)	2 (40)

* Significantly different (p <.05) proportions between job categories, chi square test

Table 16. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemical levels by current job categories among all participants (N = 187) of chemical

	Cell Operator[a] (N = 9)	Chemical Operator[b] (N = 64)	Engineer/ Lab[c] (N = 37)	Maintenance[d] (N = 17)	Mill Operator[e] (N = 24)	Secretary[f] (N = 5)	Supervisor/ Mgmt[g] (N = 26)	Waste Operator[h] (N = 5)
PFOS								
Mean	2.266	1.839	0.611	1.772	0.625	0.451	1.732	2.648
Range	0.325 – 6.840	0.189 – 7.260	0.081 – 1.740	0.291 – 4.940	0.025 – 2.040	0.220 – 1.140	0.091 – 10.600	0.254 – 7.880
G. Mean	1.643[c,d,f]	1.480[c,e,f,g]	0.390[a,b,d,g,h]	1.320[c,e,f]	0.501[a,b,d,g,h]	0.366[a,b,d,h]	0.842[b,c,e]	1.504[c,e,f]
95% C.I.	0.914 – 2.953	1.253 – 1.749	0.282 – 0.540	0.904 – 1.928	0.374 – 0.672	0.206 – 0.649	0.510 – 1.388	0.493 – 4.589
PFHS								
Mean	0.927	0.411	0.148	0.309	0.082	0.076	0.390	0.444
Range	0.083 – 1.880	0.034 – 1.860	0.005 – 0.905	0.023 – 1.240	0.001– 0.374	0.027 – 0.172	0.009 – 1.420	0.038 – 1.210
G. Mean	0.664[b,c,d,e,f,g]	0.292[a,c,d,e,f]	0.075[a,b,d,g,h]	0.178[a,d,e]	0.053[a,b,d,g,h]	0.063[a,b]	0.180[a,c,e]	0.232[c,e]
95% C.I.	0.346 – 1.274	0.239 – 0.357	0.0500 – 0.111	0.107 – 0.297	0.035 – 0.080	0.035 – 0.113	0.010 – 0.324	0.069 – 0.775
POAA								
Mean	1.811	2.196	0.343	1.512	1.218	0.167	1.289	1.663
Range	0.126 – 3.640	0.150 – 6.760	0.024 – 2.320	0.211 – 4.680	0.015 – 2.340	0.095 – 0.261	0.021 – 4.540	0.936 – 2.710
G. Mean	1.263[c,f,g]	1.849[c,d,e,f,g]	0.198[a,b,d,e,g,h]	1.052[c,f,g]	0.987[c,f,g]	0.155[a,b,d,e,g,h]	0.571[a,b,c,d,e,f,h]	1.542[c,f,g]
95% C.I.	0.619 – 2.576	1.587 – 2.154	0.141 – 0.277	0.691 – 1.602	0.668 – 1.457	0.106 – 0.226	0.312 – 1.043	1.052 – 2.259
PFOSAA								
Mean	0.009	0.042	0.010	0.037	0.022	0.002	0.009	0.009
Range	0.001 – 0.051	0.001 – 0.269	0.001 – 0.073	0.001 – 0.125	0.003 – 0.049	0.001 – 0.004	0.001 – 0.054	0.003 – 0.016
G. Mean	0.003[b,e]	0.014[a,c,d,g]	0.004[b,e]	0.015[b]	0.016[a,c]	0.001	0.005[b]	0.006
95% C.I.	0.001 – 0.008	0.009 – 0.020	0.002 – 0.005	0.007 - 0.032	0.012 – 0.023	0.001 – 0.002	0.003 – 0.008	0.003 – 0.013
M570								
Mean	0.045	0.284	0.064	0.237	0.044	0.036	0.110	0.087
Range	0.012 – 0.169	0.009 – 3.100	0.004 – 0.410	0.038 – 0.701	0.023 – 0.115	0.001 – 0.072	0.010 – 0.553	0.050 – 0.159
G. Mean	0.032[b,d]	0.143[a,c,e,f,g]	0.041[b,d]	0.186[a,c,e,f,g]	0.041[b,d]	0.029[b,d]	0.063[b,d]	0.079
95% C.I.	0.020 – 0.054	0.107 – 0.192	0.030 – 0.056	0.130– 0.267	0.036 – 0.047	0.015 – 0.057	0.041 – 0.096	0.052 – 0.121

Table 16. (continued)

PFOSA								
Mean	0.006	0.088	0.011	0.066	0.028	0.025	0.052	0.038
Range	0.0005– 0.015	0.001– 0.487	0.001 – 0.063	0.001 – 0.569	0.0005 – 0.204	0.003 – 0.080	0.0005 – 0.612	0.002 – 0.161
G. Mean	0.004	0.021[,c,f]	0.003[b,d,e]	0.012[c]	0.017[a,c]	0.014	0.007	0.012
95% C.I.	0.002– 0.009	0.013 – 0.033	0.002 – 0.005	0.005 – 0.027	0.011 – 0.025	0.004 – 0.042	0.003 – 0.015	0.003 – 0.048
M556								
Mean	0.013	0.074	0.024	0.088	0.014	0.015	0.044	0.047
Range	0.003 – 0.035	0.001 – 0.380	0.002 – 0.033	0.008 – 0.406	0.002 – 0.045	0.003 – 0.030	0.003 – 0.336	0.014 – 0.157
G. Mean	0.010[b,d]	0.045[a,c,e,f,g]	0.010[b,d]	0.054[a,c,e,f,g]	0.011[b,d]	0.011[b,d]	0.017[b,d]	0.027
95% C.I.	0.006 – 0.017	0.034 – 0.059	0.007 – 0.014	0.034 – 0.088	0.008 – 0.014	0.004 – 0.027	0.010 – 0.029	0.011 – 0.068

(a-h) comparison for each current job category using student's t

Table 17. Age, BMI and years worked in chemical by longest job categories of all participants (N = 187) in chemical

	Cell Operator[a] (N = 3)	Chemical Operator[b] (N = 77)	Engineer/ Lab[c] (N = 31)	Maintenance[d] (N = 20)	Mill Operator[e] (N = 26)	Secretary[f] (N = 7)	Supervisor/ Mgmt[g] (N = 15)	Waste Operator[h] (N = 3)
Age								
Mean	43	42[e,g,h]	41[e,g,h]	43[e,g]	34[b,c,d,f,g,h]	46[e]	49[b,c,d,e]	53[b,c,e]
SE	2.5	1.0	2.0	1.5	1.4	1.7	1.7	2.3
Median	45	44	41	43	32	44	50	52
Range	38 – 46	25 – 62	23 – 58	27 – 54	25 – 51	42 – 54	33 – 59	49 – 57
BMI [All negs]								
Mean	24.8	28.0	28.0	27.7	28.1	24.1	28.3	26.9
SE	3.4	0.6	0.9	0.7	1.1	1.2	1.9	2.4
Median	27.0	27.5	27.7	26.7	26.9	23.4	27.1	25.8
Range	18 – 29	18 – 47	21 – 38	23 – 33	20 – 43	21 – 30	16 – 47	23 – 32
Years Worked In Chemical								
Mean	13	13[e,g]	13[e,g]	11[e,f,g]	2[b,c,d,f,g]	20[d,e]	22[b,c,d]	11
SE	6.7	1.2	2.3	2.6	0.8	3.7	3.3	6.8
Median	11	12	8	6	1	20	26	8
Range	2 – 25	1 – 31	1 – 37	1 – 36	1 – 21	2 - 33	1 – 37	1 – 24

(a-h) comparison for each longest job category using student's t, $p < .05$

Table 18. Number (and percent) of demographic characteristics by longest job categories of all participant employees (N = 187) in chemical

	Cell Operator[a] (N = 3)	Chemical Operator[b] (N = 77)	Engineer/ Lab[c] (N = 31)	Maintenance[d] (N = 20)	Mill Operator[e] (N = 26)	Secretary[f] (N = 7)	Supervisor/ Mgmt[g] (N = 15)	Waste Operator[h] (N = 3)
Gender*	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Male	3 (100)	68 (88)	23 (74)	20 (100.00)	21 (81)	0 (0.00)	12 (80)	3 (100)
Female	0 (0)	9 (12)	8 (26)	0 (0.00)	5 (19)	7 (100.00)	3 (20)	0 (0)
Only Worked in Chemical*								
Yes	1 (33)	33 (43)	21 (68)	10 (50)	24 (92)	3 (43)	7 (47)	0 (0.00)
No	2 (67)	44 (57)	10 (32)	10 (50)	2 (8)	4 (57)	8 (53)	3 (100.00)
Hand to Mouth Contact*								
Yes	3 (100)	56 (75)	14 (45)	14 (70)	22 (85)	4 (57)	6 (40)	3 (100)
No	0 (0)	19 (25)	17 (55)	6 (30)	4 (15)	3 (43)	9 (60)	0 (0)
Wash Hands								
Always	2 (67)	63 (84)	20 (65)	17 (85)	22 (85)	4 (57)	9 (60)	2 (67)
Less Frequently	1 (33)	12 (16)	11 (35)	3 (15)	4 (15)	3 (43)	6 (40)	1 (33)

* Significantly different percentages by longest job categories, chi square, $p < .05$

Table 19. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals by longest job categories among participants (N = 187) in chemical

	Cell Operator[a] (N = 3)	Chemical Operator[b] (N = 77)	Engineer/ Lab[c] (N = 31)	Maintenance[d] (N = 20)	Mill Operator[e] (N = 26)	Secretary[f] (N = 7)	Supervisor/ Mgmt[g] (N = 15)	Waste Operator[h] (N = 3)
PFOS								
Mean	1.298	2.008	0.486	2.162	0.628	0.370	0.740	2.388
Range	0.700 – 2.260	0.093 – 7.880	0.081 – 1.740	0.291 – 10.600	0.052 – 2.040	0.129 -- 1.140	0.091 – 2.090	0.254 – 4.840
G. Mean	1.139[c,f]	1.638[c,e, f,g,]	0.313[a,b,d,e,g,h]	1.450[c,e,f,g]	0.508[b,c,d,h]	0.291[a,b,d,h]	0.543[b,c,d]	1.365[c,e,f]
95% C.I.	0.571-2.274	1.385-1.936	0.224-0.436	0.988 – 2.128	0.386 – 0.669	0.176 – 0.480	0.350 – 0.842	0.245 – 7.600
PFHS								
Mean	0.762	0.522	0.106	0.340	0.080	0.067	0.164	0.256
Range	0.381 – 1.200	0.009 – 1.880	1.005 – 0.420	0.023 – 1.250	0.001 – 0.374	0.027 – 0.172	0.010 – 0.445	0.038 – 0.562
G. Mean	0.686[c,d,e,f,g]	0.359[c,d,e,f,g]	0.061[a,b,d]	0.192[a,b,c,e,f,g]	0.052[a,b,d]	0.056[a,b,d]	0.095[a,b,d]	0.153
95% C.I.	0.358 – 1.314	0.292 – 0.441	0.041 – 0.091	0.120 – 0.309	0.035 – 0.078	0.036 – 0.088	0.050 – 0.182	0.033 – 0.703
POAA								
Mean	0.578	2.231	0.246	1.636	1.203	0.138	0.496	2.219
Range	0.470 – 0.749	0.052 – 6.760	0.024 – 1.000	0.211 – 4.680	0.015 – 2.340	0.053 – 0.261	0.021 – 1.790	0.936 – 3.680
G. Mean	0.566[b,c,f,]	1.863[a,c,d,f,g]	0.170[a,b,d,e,h]	1.147[b,c,f,g]	0.985[b,c,f,g]	0.121[a,b,d,e,h]	0.250[b,d,e,h]	1.915[c,f,g]
95% C.I.	0.428 – 0.749	1.592 – 2.180	0.124 – 0.235	0.780 – 1.686	0.686 – 1.413	0.080 – 0.184	0.131 – 0.480	0.881 – 4.166
PFOSAA								
Mean	0.019	0.035	0.010	0.033	0.021	0.001	0.007	0.008
Range	0.001 – 0.051	0.001 – 0.269	0.001 – 0.073	0.001 – 0.125	0.003 – 0.049	0.001 – 0.004	0.001 – 0.019	0.003 – 0.016
G. Mean	0.006	0.011[c,f,g]	0.004[b,d,e]	0.014[c,g]	0.016[c,f,g]	0.001[b,d,e]	0.004[b,d,e]	0.006
95% C.I.	0.001 – 0.056	0.008 – 0.016	0.002 – 0.006	0.007 – 0.027	0.012 – 0.022	0.001 – 0.002	0.002 – 0.007	0.002 – 0.016
M570								
Mean	0.064	0.259	0.050	0.242	0.045	0.031	0.067	0.104
Range	0.001 – 0.169	0.009 – 3.100	0.004 – 0.164	0.038 – 0.701	0.023 – 0.115	0.010 – 0.072	0.013 – 0.201	0.053 – 0.159
G. Mean	0.027[b,d]	0.129[a,c,e,f,g]	0.036[b,d]	0.186[a,c,e,f,g]	0.042[b,d]	0.026[b,d]	0.051[b,d]	0.094
95% C.I.	0.004 – 0.164	0.099 – 0.169	0.026 – 0.049	0.131 – 0.263	0.037 – 0.048	0.015 – 0.042	0.035 – 0.076	0.050 – 0.177

Table 19. (continued)

PFOSA								
Mean	0.008	0.079	0.011	0.087	0.029	0.021	0.021	0.014
Range	0.001 – 0.015	0.001 – 0.487	0.001 – 0.063	0.001 – 0.612	0.010 – 0.204	0.003 – 0.080	0.001 – 0.173	0.005 – 0.027
G. Mean	0.004	0.017[c,g]	0.003[b,d,e]	0.012[c,g]	0.017[c,g]	0.013[g]	0.003[b,d,e,f]	0.012
95% C.I.	0.001 – 0.031	0.011 – 0.026	0.002 – 0.006	0.005 - 0.029	0.011 – 0.025	0.006 – 0.028	0.001 – 0.007	0.005 – 0.029
M556								
Mean	0.013	0.074	0.012	0.093	0.014	0.012	0.019	0.067
Range	0.003 – 0.035	0.001 – 0.380	0.002 – 0.040	0.008 – 0.406	0.002 – 0.045	0.003 – 0.030	0.003 – 0.059	0.010 – 0.157
G. Mean	0.006[b,d,h]	0.042[a,c,e,f,g]	0.008[b,d,h]	0.054[a,c,e,f,g]	0.011[b,d]	0.008[b,d,h]	0.013[b,d]	0.037[a,c,f]
95% C.I.	0.001 – 0.034	0.033 – 0.055	0.006 – 0.011	0.034 – 0.086	0.008 – 0.014	0.004 – 0.017	0.007 – 0.021	0.008 – 0.180

(a-h) comparison for each longest job category using student's t, $p < .05$

Table 20. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals of all participants (N = 187) who currently work in only one building/area in chemical

	Bldg. 1 (N=23)	Bldgs. 2/49 (N=12)	Bldg. 3 (N=30)	Bldg. 4MX (N=20)	Bldg. 4N (N=5)	Waste water (N=4)
PFOS						
Mean	0.686	2.257	2.426	0.556	2.000	2.763
Range	0.081 –2.190	0.325 – 6.840	0.189 – 7.260	0.052 – 1.620	1.440 – 2.670	0.254 – 7.880
G. Mean	0.438	1.727	2.000	0.468	1.937	1.369
95% C.I.	0.281 – 0.681	1.023 – 2.916	1.544 – 2.590	0.336 – 0.653	1.378 – 2.723	0.136 – 13.741
PFHS						
Mean	0.194	0.870	0.567	0.079	0.450	0.386
Range	0.013 – 0.713	0.076 – 1.880	0.139 – 1.860	0.001 – 0.374	0.161 – 0.832	0.038 – 1.210
G. Mean	0.101	0.585	0.417	0.050	0.397	0.177
95% C.I.	0.059 – 0.173	0.292 – 1.171	0.309 – 0.561	0.030 – 0.084	0.192 – 0.821	0.018 – 1.729
POAA						
Mean	0.426	1.807	2.665	1.176	2.088	1.804
Range	0.024 – 2.700	0.126 – 3.640	0.261 – 6.760	0.015 – 2.110	1.300 – 2.860	0.936 – 2.710
G. Mean	0.200	1.247	2.111	0.927	2.024	1.677
95% C.I.	0.119 – 0.331	0.631 – 2.461	1.587 – 2.809	0.568 – 1.515	1.420 – 2.886	0.815 – 3.452
PFOSAA						
Mean	0.010	0.008	0.049	0.021	0.019	0.010
Range	0.001 – 0.054	0.001 – 0.051	0.002 – 0.269	0.002 – 0.049	0.004 – 0.043	0.003 – 0.017
G. Mean	0.002	0.003	0.020	0.015	0.011	0.007
95% C.I.	0.002 – 0.006	0.001 – 0.007	0.012 – 0.034	0.010 – 0.024	0.003 – 0.048	0.002 – 0.031
M570						
Mean	0.077	0.043	0.481	0.040	0.099	0.091
Range	0.006 – 0.410	0.010 – 0.169	0.063 – 3.100	0.024 – 0.613	0.054 – 0.205	0.050 – 0.159
G. Mean	0.050	0.031	0.348	0.039	0.088	0.081
95% C.I.	0.033 – 0.075	0.018 – 0.052	0.260 – 0.465	0.035 – 0.044	0.047 – 0.165	0.034 – 0.195

Table 20. (continued)

PFOSA						
Mean	0.018	0.006	0.109	0.028	0.251	0.007
Range	0.0005 – 0.161	0.0005 – 0.021	0.003 – 0.569	0.0005 – 0.204	0.003 – 0.487	0.002 – 0.011
G. Mean	0.005	0.003	0.037	0.017	0.059	0.006
95% C.I.	0.003 – 0.010	0.002 – 0.006	0.020 – 0.066	0.010 - 0.028	0.002 – 1.595	0.002– 0.019
M556						
Mean	0.021	0.013	0.121	0.011	0.076	0.055
Range	0.003 – 0.127	0.003 – 0.347	0.024 – 0.380	0.002 – 0.030	0.025 – 0.175	0.015 – 0.157
G. Mean	0.013	0.010	0.095	0.010	0.057	0.033
95% C.I.	0.008 – 0.020	0.006 – 0.017	0.073 – 0.125	0.007 – 0.013	0.019 – 0.163	0.006 – 0.193
Years in chemical						
Mean	20	19	10	3	13	13

Table 21. Mean, range, geometric mean and 95% confidence interval of geometric mean for all participants (N = 187) who said they have only worke in one building/area in chemical

	Bldg. 1 (N = 11)	Bldg. 3 (N = 8)	Bldg. 4 MX (N=17)
PFOS			
Mean	0.432	2.693	0.501
Range	0.081 – 1.700	1.450 – 5.120	0.052 – 0.383
G. Mean	0.282	2.427	0.467
95% C.I.	0.150 – 0.529	1.619 – 3.638	0.321 – 0.681
PFHS			
Mean	0.100	0.890	0.053
Range	0.013 – 0.42	0.151 – 1.860	0.01 – 0.152
G. Mean	0.058	0.578	0.045
95% C.I.	0.027 – 0.124	0.236 – 1.420	0.026 – 0.076
POAA			
Mean	0.155	2.947	0.987
Range	0.024 – 0.386	0.366 – 6.760	0.015 – 1.850
G. Mean	0.115	2.079	0.817
95% C.I.	0.064 – 0.201	0.923 – 4.681	0.467 – 1.429
PFOSAA			
Mean	0.003	0.027	0.023
Range	0.001 – 0.011	0.005 – 0.118	0.003 – 0.049
G. Mean	0.002	0.014	0.017
95% C.I.	0.001 – 0.003	0.005 – 0.036	0.011 – 0.026
M570			
Mean	0.062	0.308	0.044
Range	0.02– 0.201	0.03– 0.480	0.026 – 0.061
G. Mean	0.041	0.270	0.045

Table 21. (continued)

95% C.I.	0.021 – 0.080	0.158 – 0.462	0.035 – 0.057
PFOSA			
Mean	0.013	0.151	0.031
Range	0.0005 – 0.060	0.003 – 0.569	0.0005 – 0.204
G. Mean	0.006	0.059	0.018
95% C.I.	0.002 – 0.016	0.013 – 0.266	0.009 – 0.036
M556			
Mean	0.017	0.095	0.013
Range	0.04– 0.059	0.05– 0.214	0.06– 0.022
G. Mean	0.012	0.080	0.014
95% C.I.	0.006 – 0.023	0.047 – 0.136	0.009 – 0.021
Years in chemical			
Mean	20	17	1.3

Table 22. Mean, median and range, by gender, of chemical operators and engineer/lab for random sample by age, BMI and years worked in chemical

	Chemical Operators		Engineer/Lab	
	Female	Male	Female	Male
Age				
Mean	41.3	42.4	36.0	42.7
Median	40	44	35	43
Range	28 – 61	25 – 62	23 – 54	27 – 58
BMI				
Mean	26.9	28.6	24.0	29.0
Median	27.4	28.4	22.2	28.2
Range	22.0 – 32.7	20.2 – 47.5	20.7 – 30.2	18.5 – 38.4
Years Worked In Chemical				
Mean	9.6	11.4	9.6	16.5
Median	10.5	10.0	1.3	15.0
Range	3 - 20	1 - 31	1 - 33	1 - 37

Table 23. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals by gender for random sample chemical plant employees whose current job was chemical operator or engineer/lab

	Chemical Operators		Engineer/Lab	
	Female (N = 10)	Male (N = 37)	Female (N = 6)	Male (N = 17)
PFOS				
Mean	1.183	1.943	0.167	0.799
Range	0.471 – 2.380	0.490 – 7.260	0.101 – 0.281	0.095 – 1.740
G. Mean	1.051*	1.625	0.157*	0.540
95% C.I.	0.764 – 1.447	1.345 – 1.962	0.115 – 0.214	0.336 – 0.868
PFHS				
Mean	0.190*	0.492	0.032	0.220
Range	0.071 – 0.404	0.134 – 1.860	0.005 – 0.081	0.018 – 0.905
G. Mean	0.167*	0.364	0.023*	0.121
95% C.I.	0.119 – 0.235	0.285 – 0.465	0.011 – 0.048	0.069 – 0.210
POAA				
Mean	1.342*	2.497	0.103	0.473
Range	0.150 – 2.110	0.745 – 6.760	0.035 – 0.300	0.051 – 2.320
G. Mean	0.129*	2.168	0.078*	0.295
95% C.I.	0.701 – 1.818	1.829 – 2.570	0.043 – 0.141	0.186 – 0.468
PFOSAA				
Mean	0.012	0.041	0.004	0.017
Range	0.001 – 0.109	0.001 – 0.269	0.001 – 0.018	0.001 – 0.073
G. Mean	0.006	0.013	0.002	0.008
95% C.I.	0.002 – 0.016	0.008 – 0.022	0.001 – 0.005	0.004 – 0.084
M570				
Mean	0.114	0.260	0.046	0.084
Range	0.029 – 0.357	0.009 – 0.992	0.020 – 0.093	0.008 – 0.410
G. Mean	0.087	0.146	0.039	0.053
95% C.I.	0.055 – 0.139	0.099 – 0.217	0.024 – 0.064	0.033 – 0.084

Table 23. (continued)

PFOSA				
Mean	0.063	0.109	0.017	0.017
Range	0.003 – 0.315	0.001 – 0.487	0.0005 – 0.063	0.0005 – 0.060
G. Mean	0.022	0.030	0.005	0.004
95% C.I.	0.007 – 0.062	0.016 – 0.055	0.001 – 0.024	0.002 – 0.010
M556				
Mean	0.041	0.083	0.010	0.022
Range	0.007 – 0.118	0.001 – 0.380	0.003 – 0.027	0.002 – 0.127
G. Mean	0.027	0.050	0.007	0.010
95% C.I.	0.014 – 0.050	0.035 – 0.073	0.004 – 0.014	0.006 – 0.019

* $p < 0.05$

Table 24. Distribution of film plant participants: random sample, volunteers and all participants

	Film Plant		
	Random Sample	Volunteers	All Participants
Have worked only in film plant	42	14	56
(Have worked on D-1 maker)	(6)	(1)	(7)
(Have not worked on D-1 maker)	(36)	(13)	(49)
Work in film plant with previous work in chemical	18	2	20
Total	60	16	76

Table 25. Demographic characteristics of random sample (N = 60) of film plant employees including subsets: employees with only film plant experience; employees known to have worked on D-1 Maker; and employees with prior chemical history

	All (N = 60)		Only Film (N = 36)		D-1 Maker (N = 6)		Film w/ history of chemical (N = 18)	
Age								
Mean	46		44		46		48	
SE	1.1		1.5		3.6		2.1	
Median	47		46		48		51	
Range	23 - 59		23 – 59		3(– 55		28 – 58	
BMI								
Mean	28.0		28.2		?6.9		28.0	
SE	0.6		0.8		1.9		1.1	
Median	27.8		27.8		?7.5		27.6	
Range	18.0 – 41.8		18.0 – 41.8		21.7 – 31.7		20.0 – 37.9	
Years worked In film								
Mean	13.7		13.7		9.2		15.4	
SE	10.0		1.7		4.1		2.4	
Median	14		14		6		16	
Range	0.1 – 36.0		0.1 – 29		1 – 21		1 – 36	
Gender								
Female	11	(18)	6	(17)	1	(17)	4	(22)
Male	49	(82)	30	(83)	5	(83)	14	(78)
Current job								
Engineer/Lab	16	(27)	10	(28)	0	(0)	6	(33)
Film processor	23	(38)	12	(33)	5	(83)	6	(33)
Maintenance	10	(17)	7	(19)	1	(17)	2	(11)
Administrative	11	(18)	7	(19)	0	(0)	4	(22)
Longest job								
Engineer/Lab	13	(22)	7	(19)	0	(0)	6	(33)
Film processor	26	(43)	15	(42)	5	(83)	6	(33)
Maintenance	11	(18)	8	(22)	1	(17)	2	(11)
Administrative	10	(17)	6	(17)	0	(0)	4	(22)
Hand to mouth contact								
Yes	37	(62)	26	(72)	4	(67)	7	(39)
No	23	(38)	10	(28)	2	(33)	11	(61)
Wash hands								
Yes	50	(83)	28	(78)	6	(100)	16	(89)
No	10	(17)	8	(22)	0	(0)	2	(11)

Table 26. Mean, range, geometric mean and 95% confidence interval of geometric mean for random sample of film plant employees by work history: only film, D-1 Maker or film with prior chemical work history

	Only Film[a] (N = 35)	D-1 Maker[b] (N = 6)	Film with previous history in chemical[c] (N = 18)
PFOS			
Mean	0.122	0.367	0.212
Range	0.032 – 0.250	0.122 – 0.946	0.080 – 0.692
G. Mean	0.110[bc]	0.289[a]	0.178[a]
95% C.I.	0.094 – 0.129	0.159 – 0.527	0.137 – 0.233
PFHS			
Mean	0.015	0.023	0.038
Range	0.001 – 0.075	0.005 – 0.030	0.007 – 0.210
G. Mean	0.010[c]	0.020	0.023[a]
95% C.I.	0.008 – 0.014	0.011 – 0.034	0.015 – 0.036
POAA			
Mean	0.052	0.122	0.090
Range	0.006 – 0.298	0.020 – 0.197	0.012 – 0.246
G. Mean	0.037[b,c]	0.093[a]	0.067[a]
95% C.I.	0.028 – 0.049	0.044 – 0.196	0.044 – 0.100
PFOSAA			
Mean	0.003	0.006	0.005
Range	0.001 – 0.009	0.001 – 0.022	0.001 – 0.038
G. Mean	0.002	0.004	0.003
95% C.I.	0.002 – 0.003	0.022 – 0.009	0.002 – 0.005
M570			
Mean	0.022	0.018	0.018
Range	0.0008 – 0.454	0.0021 – 0.053	0.0014 – 0.069
G. Mean	0.007	0.010	0.010
95% C.I.	0.005 – 0.010	0.006 – 0.017	0.004 – 0.026
M556			
Mean	0.022	0.005	All values < LOQ
Range	0.0001 – 0.307	0.001 – 0.014	
G. Mean	0.003	0.003	
95% C.I.	0.001 – 0.006	0.002 – 0.004	

(a-c) comparison for each current job category using student's t, $p < .05$

Table 27. Ratio of fluorochemical levels by random sample of film employees including subsets: employees only with film plant experience; employees known to have worked on D-1 Maker; and employees with prior chemical history

	Only Film (N = 36)	D-1 Maker (N = 6)	Film With Previous History In Chemical (N = 18)
PFOS/PFHS			
Mean	14.9	18.8	9.3
Median	10.4	12.7	7.4
Range	1.8 – 107.6	5.0 – 46.6	3.3 – 32.0
PFOS/POAA			
Mean	3.3	5.7	3.2
Median	2.8	2.4	2.3
Range	0.7 – 9.2	0.9 – 21.0	1.2 – 10.1
PFOS/Analytes			
Mean	10.0	25.6	12.6
Median	7.8	11.5	10.3
Range	0.2 – 37.6	2.1 – 91.8	3.0 – 40.7
PFOSAA/M556			
Mean	1.9	2.8	2.1
Median	1.0	1.3	1.2
Range	0.003 – 14.0	0.3 – 10.9	0.4 – 15.1
M570/M556			
Mean	5.0	6.9	7.1
Median	2.3	3.4	4.5
Range	0.3 – 45.0	0.8 – 28.2	0.6 – 27.6

Table 28. Demographic characteristics of random sample of film plant employees by current job categories who have worked only in the film plant (i.e., not on the D-1 Maker or prior work in chemical)

	Engineer/Lab (N = 10)	Film Processor (N = 12)	Maintenance (N = 7)	Administrative (N = 7)
Age				
Mean	46	44	40	48
SE	2.8	2.5	3.3	3.3
Median	48	47	40	50
Range	23 - 58	27 – 59	31 – 51	40 – 55
BMI				
Mean	26.8	28.6	28.7	29.2
SE	1.5	1.4	1.8	1.8
Median	27.3	27.8	29.5	27.9
Range	21.6 – 31.7	18.0 – 41.8	24.1 – 32.9	24.4 – 41.8
Years worked In film				
Mean	14.8	14.1	4.6	20.4
SE	2.9	2.6	3.4	3.4
Median	15	17	3	25
Range	0.1 – 29	0.5 – 29	0.5 – 12	5 – 28
Gender				
Female	2 (20)	2 (17)	0 (0)	2 (29)
Male	8 (80)	10 (83)	7 (100)	5 (71)
Hand to mouth Contact				
Yes	8 (80)	10 (83)	4 (57)	4 (57)
No	2 (20)	2 (17)	3 (43)	3 (43)
Wash hands				
Yes	8 (80)	10 (83)	6 (86)	4 (57)
No	2 (20)	2 (17)	1 (14)	3 (43)

Table 29. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals for random sample of employees who have only worked in the film plant (i.e., not on the D-1 Maker or prior work in chemical)

	Engineer/Lab[a] (N = 10)	Film Processor[b] (N = 12)	Maintenance[c] (N = 7)	Administrative[d] (N = 7)
PFOS				
Mean	0.097	0.127	0.159	0.111
Range	0.055 – 0.140	0.032 – 0.250	0.137 – 0.216	0.054 – 0.166
G. Mean	0.093[c]	0.106	0.157[a]	0.104
95% C.I.	0.074 – 0.116	0.074 – 0.154	0.139 – 0.177	0.077 – 0.140
PFHS				
Mean	0.016	0.015	0.016	0.012
Range	0.001– 0.075	0.004 – 0.047	0.001 – 0.034	0.006 – 0.033
G. Mean	0.009	0.011	0.011	0.010
95% C.I.	0.005 – 0.018	0.007 – 0.017	0.005 – 0.026	0.006 – 0.016
POAA				
Mean	0.030	0.055	0.098	0.039
Range	0.006 – 0.055	0.007 – 0.154	0.021– 0.298	0.017 – 0.063
G. Mean	0.022[c]	0.041	0.071[a]	0.035
95% C.I.	0.014 – 0.036	0.024 – 0.068	0.038 – 0.132	0.024 – 0.051
PFOSAA				
Mean	0.002	0.002	0.002	0.004
Range	0.001 – 0.005	0.001 – 0.009	0.001 – 0.006	0.001 – 0.006
G. Mean	0.002	0.002	0.002	0.004
95% C.I.	0.001 – 0.003	0.001 – 0.003	0.001 – 0.003	0.002 – 0.006
M570				
Mean	0.006	0.048	0.018	0.005
Range	0.002 – 0.017	0.003 – 0.454	0.006 – 0.046	0.001 – 0.009
G. Mean	0.005[c]	0.010	0.014[a d]	0.004[c]
95% C.I.	0.004 – 0.007	0.004 – 0.022	0.009 – 0.024	0.002 – 0.007
M556				
Mean	0.002	0.029	0.005	0.002
Range	0.0001 – 0.003	0.003 – 0.307	0.001 – 0.016	0.001 – 0.003
G. Mean	0.001[b]	0.005[a]	0.004	0.002
95% C.I.	0.001 – 0.003	0.002 – 0.011	0.002 – 0.007	0.002 – 0.003

(a-d) comparisons for each current job category using student's t

Table 30. Ratio of fluorochemical levels by current job among random sample of film employees who only have worked in film and not on the D-1 Maker

	Engineer/Lab (N = 10)	Film Processor (N = 12)	Maintenance (N = 7)	Administrative (N = 7)
PFOS/PFHS				
Mean	13.0	13.0	24.6	11.1
Median	7.5	12.8	12.2	10.4
Range	1.8 – 61.6	4.9 – 29.0	4.3 – 107.6	5.1 – 16.5
PFOS/POAA				
Mean	4.0	3.2	2.7	3.0
Median	3.0	3.2	2.1	2.8
Range	1.3 – 9.2	1.2 – 6.3	0.7 – 5.7	2.2 – 4.2
PFOS/Analytes				
Mean	10.4	10.0	7.1	12.4
Median	10.5	4.3	7.0	9.5
Range	2.1 – 17.8	0.2 – 31.2	4.0 – 11.6	5.2 – 37.6
PFOSAA/M556				
Mean	3.6	0.7	1.3	2.1
Median	1.1	0.5	0.5	2.3
Range	0.5 – 14.0	0.003 – 1.5	0.1 – 5.1	0.5 – 4.4
M570/M556				
Mean	8.6	3.1	5.6	2.6
Median	2.5	1.6	5.9	2.8
Range	1.0 – 45.0	0.6 – 18.4	0.4 – 10.5	0.3 – 5.5

Table 31. Demographic characteristics of all film plant participants (N = 76) by only film plant, D-1 Maker or film plant with previous history in chemical

	All (N = 76)	Only Film (N = 49)	D-1 Maker (N = 7)	Film w/ history of chemical (N = 20)
Age				
Mean	45	44	44	47
SE	1.0	3.6	1.2	2.1
Median	47	45	47	51
Range	23 - 59	23 – 59	30 – 55	28 – 58
BMI				
Mean	28.3	28.5	26.6	28.5
SE	0.5	0.6	1.5	1.0
Median	27.9	27.9	26.5	28.0
Range	18.0 – 41.8	18.0 – 41.8	21.7 – 31.7	20.0 – 37.9
Years worked In film				
Mean	14.4	15.2	8.1	14.6
SE	1.2	1.4	3.5	2.5
Median	16.0	17.0	2.0	15.0
Range	0.1 – 36.0	0.1 – 30	1 – 21	1 – 36
Gender				
Female	16 (21)	8 (16)	2 (29)	6 (30)
Male	60 (79)	41 (84)	5 (71)	14 (70)
Current job				
Engineer/Lab	18 (24)	12 (25)	0 (0)	6 (30)
Film processor	34 (45)	20 (41)	6 (86)	8 (40)
Maintenance	11 (14)	8 (16)	1 (14)	2 (10)
Administrative	13 (17)	9 (18)	0 (0)	4 (20)
Longest job				
Engineer/Lab	14 (18)	8 (16)	0 (0)	6 (30)
Film processor	38 (50)	24 (49)	6 (86)	8 (40)
Maintenance	12 (16)	9 (18)	1 (14)	2 (10)
Administrative	12 (16)	8 (16)	0 (0)	4 (20)
Hand to mouth contact				
Yes	49 (64)	36 (73)	5 (71)	8 (40)
No	27 (36)	13 (27)	2 (29)	12 (60)
Wash hands				
Yes	65 (86)	40 (82)	7 (100)	18 (90)
No	11 (14)	9 (18)	0 (0)	2 (10)

Table 32. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals for all film plant participant employees by work history: only film plant, D-1 Maker or film plant with previous history in chemical

	Only Film[a] (N = 49)	D-I Maker[b] (N = 7)	Film with previous history in chemical[c] (N = 20)
PFOS			
Mean	0.129	0.347	0.220
Range	0.032 – 0.264	0.122 – 0.946	0.080 – 0.692
G. Mean	0.116[bc]	0.279[a]	0.185[a]
95% C.I.	0.101 – 0.133	0.168 – 0.461	0.144 – 0.238
PFHS			
Mean	0.016	0.022	0.038
Range	0.001 – 0.075	0.005 – 0.030	0.007 – 0.210
G. Mean	0.011[c]	0.019	0.024[a]
95% C.I.	0.009 – 0.014	0.012 – 0.030	0.016 – 0.036
POAA			
Mean	0.057	0.146	0.146
Range	0.006 – 0.298	0.020 – 0.290	0.012 – 1.220
G. Mean	0.040[b,c]	0.109[a]	0.078[a]
95% C.I.	0.031 – 0.051	0.054 – 0.221	0.049 – 0.124
PFOSAA			
Mean	0.003	0.006	0.006
Range	0.001 – 0.020	0.001 – 0.022	0.001 – 0.038
G. Mean	0.004	0.004	0.003
95% C.I.	0.002 – 0.003	0.002 – 0.009	0.002 – 0.005
M570			
Mean	0.018	0.039	0.017
Range	0.001 – 0.454	0.002 – 0.164	0.001 – 0.069
G. Mean	0.007	0.015	0.010
95% C.I.	0.005 – 0.009	0.005 – 0.046	0.006 – 0.016
M556			
Mean	0.009	0.006	All values < LOQ
Range	0.0001 – 0.307	0.001 – 0.015	
G. Mean	0.003	0.004	
95% C.I.	0.002 – 0.004	0.002 – 0.008	

(a-c) comparison for each current job category using student's t, $p < .05$

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Table 33. Mean, range, geometric mean and 95% confidence interval of geometric mean of serum fluorochemicals for all film plant participant employees who only worked in film plant (i.e., not on the D-1 Maker or worked previously in chemical)

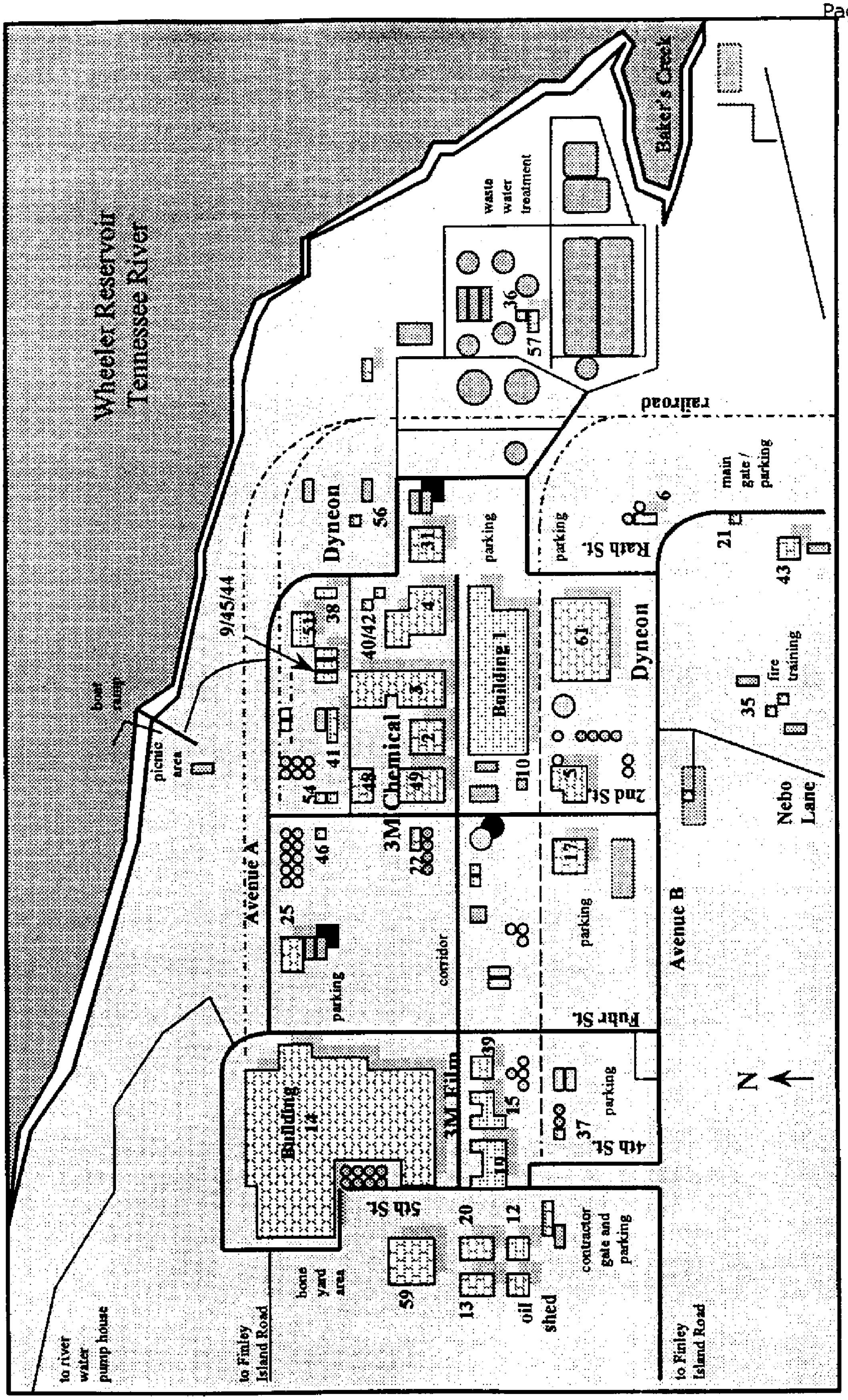
	Engineer/Lab[a] (N = 12)	Film Processor[b] (N = 20)	Maintenance[c] (N = 8)	Administrative[d] (N = 9)
PFOS				
Mean	0.108	0.133	0.168	0.108
Range	0.055 – 0.170	0.032 – 0.264	0.137 – 0.237	0.054 – 0.166
G. Mean	0.102[c]	0.114	0.165[a,d]	0.103[c]
95% C.I.	0.082 – 0.127	0.088 – 0.148	0.143 – 0.191	0.081 – 0.129
PFHS				
Mean	0.018	0.016	0.016	0.012
Range	0.001– 0.075	0.004 – 0.052	0.001 – 0.034	0.006 – 0.033
G. Mean	0.011	0.012	0.011	0.010
95% C.I.	0.006 – 0.012	0.009 – 0.017	0.006 – 0.023	0.007 – 0.015
POAA				
Mean	0.049	0.055	0.095	0.037
Range	0.006 – 0.188	0.007 – 0.154	0.021 – 0.298	0.017 – 0.063
G. Mean	0.031[c]	0.040	0.072[a]	0.033
95% C.I.	0.017 – 0.054	0.027 – 0.060	0.042 – 0.124	0.025 – 0.046
PFOSAA				
Mean	0.002	0.005	0.004	0.004
Range	0.001 – 0.005	0.001 – 0.020	0.001 – 0.017	0.001 – 0.006
G. Mean	0.002	0.003	0.002	0.003
95% C.I.	0.001 – 0.003	0.002 – 0.005	0.001 – 0.005	0.002 – 0.005
M570				
Mean	0.006	0.031	0.017	0.005
Range	0.002 – 0.017	0.002 – 0.454	0.006 – 0.046	0.001 – 0.009
G. Mean	0.005	0.008	0.014	0.004
95% C.I.	0.003 – 0.007	0.005 – 0.013	0.009 – 0.022	0.002 – 0.006
M556				
Mean	0.002	0.019	0.005	0.003
Range	0.0001 – 0.007	0.001 – 0.307	0.001 – 0.016	0.001 – 0.006
G. Mean	0.001[b]	0.004[a]	0.014	0.002
95% C.I.	0.001 – 0.003	0.002 – 0.006	0.002 – 0.007	0.002 – 0.003

(a-c) comparisons for each current job category using student's t, $p < .05$

Appendix A

Decatur Plant Maps

3M Decatur, Alabama Plant Layout
Revised 9/16/97



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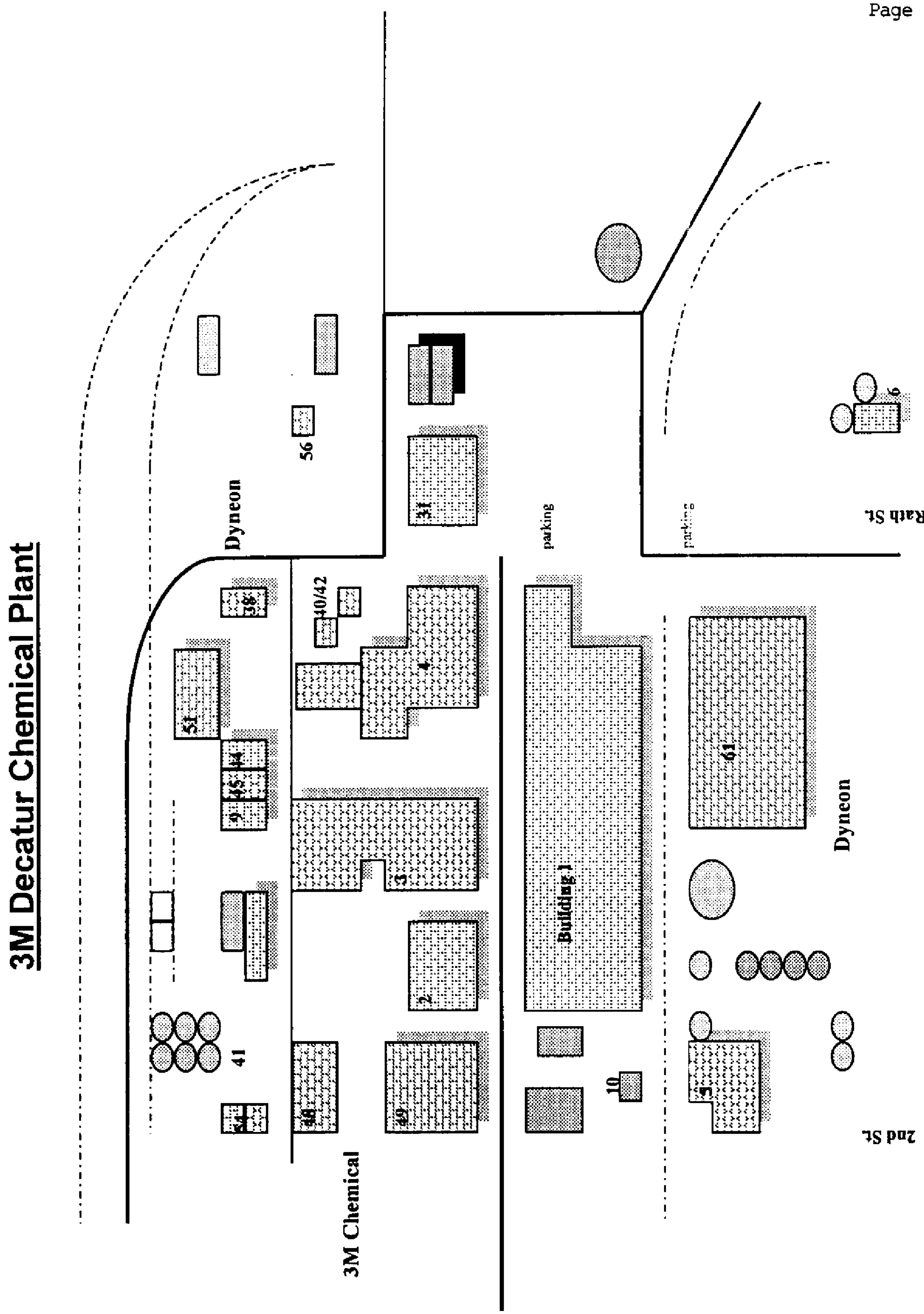
3M Decatur Chemical Plant
Dyneon
56
31
parking
parking
Rath St.
38
40/42
51
4
44
45
9
3
61
Dyneon
Building 1
2
41
54
48
49
10
5
2nd St.
3M Chemical

Appendix B

Study Questionnaire

DECATUR EMPLOYEE QUESTIONNAIRE

Thank you for participating in this research study. Please respond to each question with either a short answer or an 'x' in the appropriate box.

NAME______________________________ EMPLOYEE NUMBER____________

1. Have you *ever* worked in the Chemical Plant? Yes ☐ No ☐

   If no, please go to question 2

   If 'yes'

   a. How many years have you worked in the chemical plant? Years=__________

   b. What year did you start working in the chemical plant? Year = ____________

2. Please indicate if you have *ever* worked in the following areas. Mark an 'x' in all boxes that apply to you.

   ☐ Building 1
   ☐ Buildings 2 and/or 49
   ☐ Building 3 (OSCL/OSF area)
   ☐ Building 3 (besides OSCL/OSF area)
   ☐ Building 4 North
   ☐ Building 4 millroom/extruder
   ☐ Building 17
   ☐ Buildings 38 and/or 51
   ☐ Building 42 (Packaging FC inerts)
   ☐ Building 61
   ☐ Film Plant (all buildings)
   ☐ Wastewater treatment plant (Buildings 36 and 57)
   ☐ Other (Please specify)________________________

3. Thinking about the job that you worked for the longest period of time while employed at 3M Decatur, please answer the following questions.

   a. Job title:________________________________

   b. When did you work there: From______(year) to__________(year)

   c. Average number of hours per week on this job? Hours =________

   d. When you worked overtime, what was your usual job assignment?____________________

4. Please answer the following questions regarding your current job.

   Current plant: Chemical ☐ Film ☐ Other ☐

   Current job title:____

   What year did you start working in this current job: Year = _________

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Average number of hours per week on this job: Hours = ________

When you work overtime, what is your usual job assignment?_______________________

5. Please indicate in which area(s) you work in your *current* job. Mark an 'x' in all boxes that apply to you.

☐ Building 1
☐ Buildings 2 and/or 49
☐ Building 3 (OSCL/OSF area)
☐ Building 3 (besides OSCL/OSF area)
☐ Building 4 North
☐ Building 4 millroom/extruder
☐ Building 17
☐ Buildings 38 and/or 51
☐ Building 42 (Packaging FC inerts)
☐ Building 61
☐ Film Plant (all buildings)
☐ Wastewater treatment plant (Buildings 36 and 57)
☐ Other (Please specify)_______________________

6. While at work, do you chew gum?

☐ always ☐ frequently ☐ sometimes ☐ rarely ☐ never

7. While at work, do you chew tobacco?

☐ a. always ☐ frequently ☐ sometimes ☐ rarely ☐ never

8. While at work, do you smoke cigarettes?

☐ always ☐ frequently ☐ sometimes ☐ rarely ☐ never

9. How frequently do you wash your hands before eating while at work? Mark only one box.

☐ always ☐ frequently ☐ sometimes ☐ rarely ☐ never

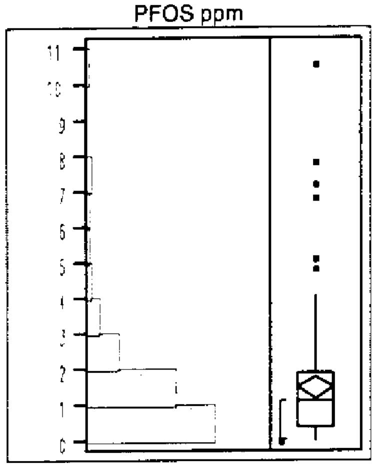
10. What is your height? Feet = _______ Inches = _______

11. What is your weight Pounds = ___________

Appendix C

Distribution of Fluorochemicals and Their Natural Log Transformation
Among Chemical Employees(N = 126) in the Random Sample

Chemical Plant
Random Sample
PFOS ppm



Quantiles

maximum	100.0%	10.600
	99.5%	10.600
	97.5%	7.187
	90.0%	3.132
quartile	75.0%	1.925
median	50.0%	1.140
quartile	25.0%	0.440
	10.0%	0.215
	2.5%	0.102
	0.5%	0.091
minimum	0.0%	0.091

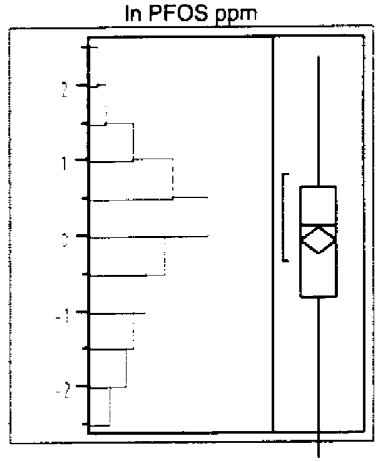
Moments

Mean	1.5047
Std Dev	1.6122
Std Error Mean	0.1436
Upper 95% Mean	1.7890
Lower 95% Mean	1.2204
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.734399	0.0000

Chemical Plant
Random Sample
ln PFOS ppm



Quantiles

maximum	100.0%	2.3609
	99.5%	2.3609
	97.5%	1.9720
	90.0%	1.1415
quartile	75.0%	0.6549
median	50.0%	0.1310
quartile	25.0%	-0.8215
	10.0%	-1.5388
	2.5%	-2.2793
	0.5%	-2.3936
minimum	0.0%	-2.3936

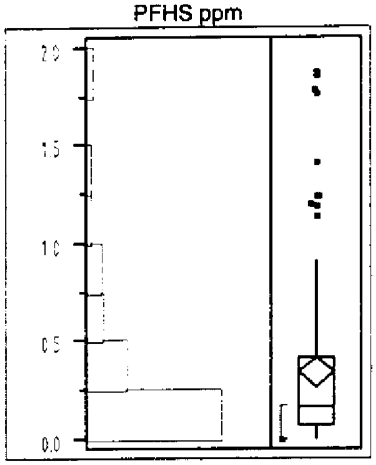
Moments

Mean	-0.0605
Std Dev	1.0263
Std Error Mean	0.0914
Upper 95% Mean	0.1204
Lower 95% Mean	-0.2415
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.967746	0.0521

Chemical Plant
Random Sample
PFHS ppm



Quantiles

maximum	100.0%	1.8800
	99.5%	1.8800
	97.5%	1.7865
	90.0%	0.8777
quartile	75.0%	0.4200
median	50.0%	0.1700
quartile	25.0%	0.0784
	10.0%	0.0334
	2.5%	0.0137
	0.5%	0.0054
minimum	0.0%	0.0054

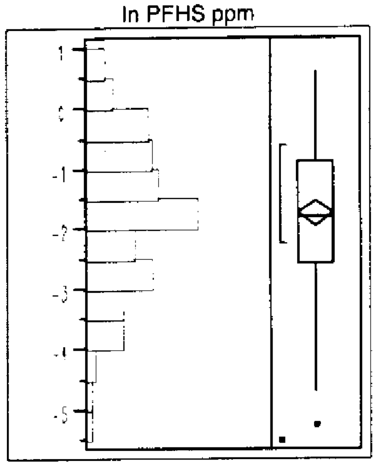
Moments

Mean	0.3450
Std Dev	0.4117
Std Error Mean	0.0367
Upper 95% Mean	0.4176
Lower 95% Mean	0.2724
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.729906	0.0000

Chemical Plant
Random Sample
ln PFHS ppm



Quantiles

maximum	100.0%	0.6313
	99.5%	0.6313
	97.5%	0.5802
	90.0%	-0.1307
quartile	75.0%	-0.8675
median	50.0%	-1.7720
quartile	25.0%	-2.5461
	10.0%	-3.4007
	2.5%	-4.3022
	0.5%	-5.2269
minimum	0.0%	-5.2269

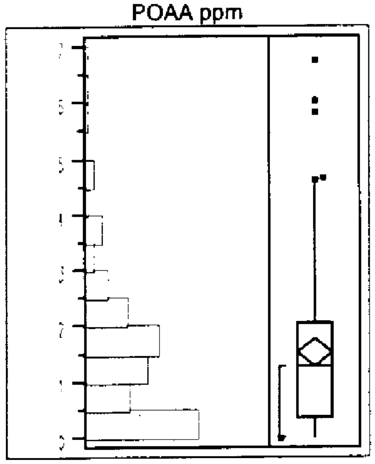
Moments

Mean	-1.7152
Std Dev	1.2225
Std Error Mean	0.1089
Upper 95% Mean	-1.4996
Lower 95% Mean	-1.9307
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.975283	0.2302

Chemical Plant
Random Sample
POAA ppm



Quantiles

maximum	100.0%	6.7600
	99.5%	6.7600
	97.5%	5.6618
	90.0%	3.4300
quartile	75.0%	2.0725
median	50.0%	1.3000
quartile	25.0%	0.3860
	10.0%	0.1281
	2.5%	0.0514
	0.5%	0.0209
minimum	0.0%	0.0209

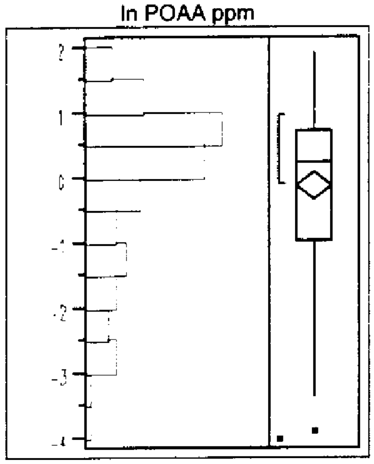
Moments

Mean	1.5363
Std Dev	1.3359
Std Error Mean	0.1190
Upper 95% Mean	1.7718
Lower 95% Mean	1.3007
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.875366	<.0001

Chemical Plant
Random Sample
ln POAA ppm



Quantiles

maximum	100.0%	1.9110
	99.5%	1.9110
	97.5%	1.7302
	90.0%	1.2318
quartile	75.0%	0.7288
median	50.0%	0.2624
quartile	25.0%	-0.9519
	10.0%	-2.0550
	2.5%	-2.9685
	0.5%	-3.8680
minimum	0.0%	-3.8680

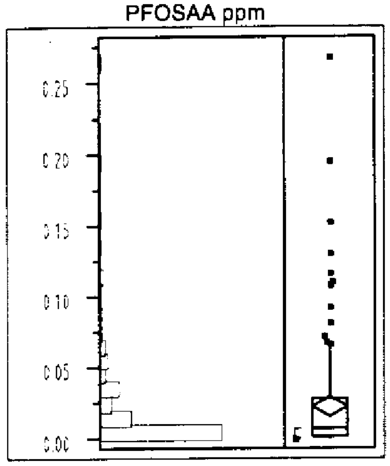
Moments

Mean	-0.1061
Std Dev	1.2545
Std Error Mean	0.1118
Upper 95% Mean	0.1151
Lower 95% Mean	-0.3273
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.903769	<.0001

Chemical Plant
Random Sample
PFOSAA ppm



Quantiles

maximum	100.0%	0.26900
	99.5%	0.26900
	97.5%	0.14915
	90.0%	0.06331
quartile	75.0%	0.02812
median	50.0%	0.00808
quartile	25.0%	0.00276
	10.0%	0.00112
	2.5%	0.00112
	0.5%	0.00112
minimum	0.0%	0.00112

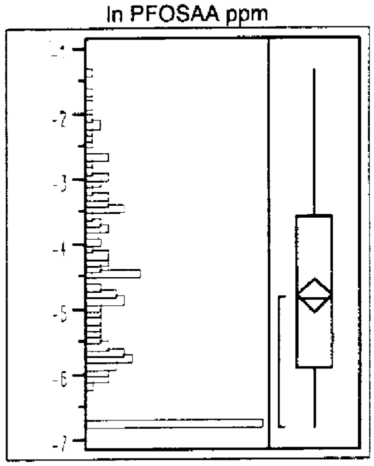
Moments

Mean	0.0233
Std Dev	0.0396
Std Error Mean	0.0035
Upper 95% Mean	0.0303
Lower 95% Mean	0.0163
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.600789	0.0000

Chemical Plant
Random Sample
ln PFOSAA ppm



Quantiles

maximum	100.0%	-1.3130
	99.5%	-1.3130
	97.5%	-1.9045
	90.0%	-2.7609
quartile	75.0%	-3.5721
median	50.0%	-4.8184
quartile	25.0%	-5.8916
	10.0%	-6.7944
	2.5%	-6.7944
	0.5%	-6.7944
minimum	0.0%	-6.7944

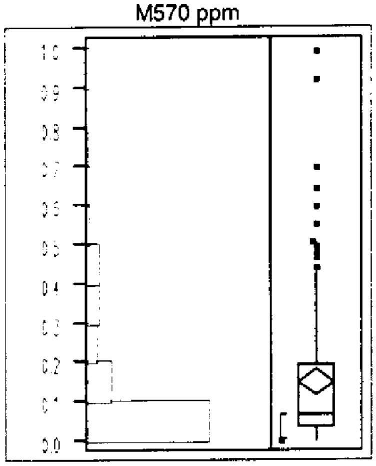
Moments

Mean	-4.7813
Std Dev	1.4592
Std Error Mean	0.1300
Upper 95% Mean	-4.5240
Lower 95% Mean	-5.0386
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.929527	<.0001

Chemical Plant
Random Sample
M570 ppm



Quantiles

maximum	100.0%	0.99200
	99.5%	0.99200
	97.5%	0.69103
	90.0%	0.41570
quartile	75.0%	0.19425
median	50.0%	0.06685
quartile	25.0%	0.03773
	10.0%	0.02173
	2.5%	0.00965
	0.5%	0.00840
minimum	0.0%	0.00840

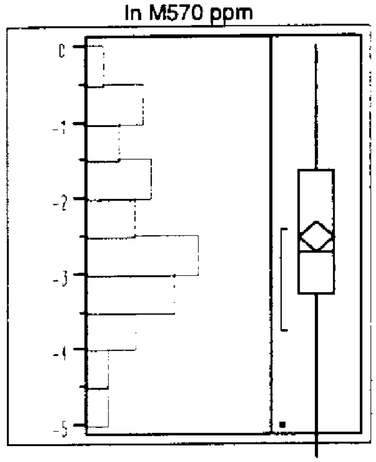
Moments

Mean	0.1505
Std Dev	0.1862
Std Error Mean	0.0166
Upper 95% Mean	0.1833
Lower 95% Mean	0.1176
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.712853	0.0000

Chemical Plant
Random Sample
ln M570 ppm



Quantiles

maximum	100.0%	-0.0080
	99.5%	-0.0080
	97.5%	-0.3701
	90.0%	-0.8780
quartile	75.0%	-1.6387
median	50.0%	-2.7053
quartile	25.0%	-3.2774
	10.0%	-3.8310
	2.5%	-4.6406
	0.5%	-4.7795
minimum	0.0%	-4.7795

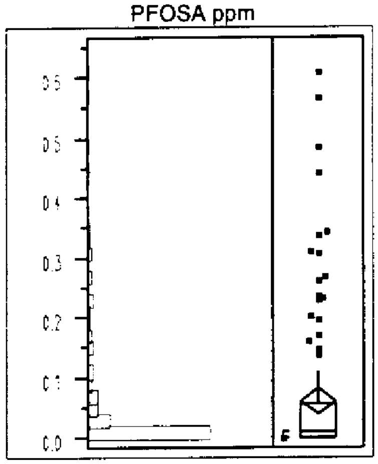
Moments

Mean	-2.5145
Std Dev	1.1167
Std Error Mean	0.0995
Upper 95% Mean	-2.3176
Lower 95% Mean	-2.7114
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.957094	0.0035

Chemical Plant
Random Sample
PFOSA ppm



Quantiles

maximum	100.0%	0.61200
	99.5%	0.61200
	97.5%	0.47948
	90.0%	0.23180
quartile	75.0%	0.05625
median	50.0%	0.01195
quartile	25.0%	0.00269
	10.0%	0.00122
	2.5%	0.00050
	0.5%	0.00050
minimum	0.0%	0.00050

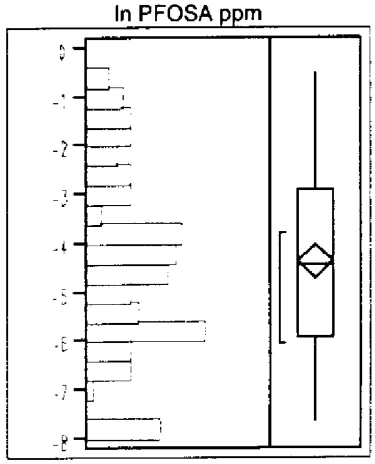
Moments

Mean	0.0618
Std Dev	0.1165
Std Error Mean	0.0104
Upper 95% Mean	0.0823
Lower 95% Mean	0.0412
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.580929	0.0000

Chemical Plant
Random Sample
ln PFOSA ppm



Quantiles

maximum	100.0%	-0.4910
	99.5%	-0.4910
	97.5%	-0.7357
	90.0%	-1.4620
quartile	75.0%	-2.8787
median	50.0%	-4.4277
quartile	25.0%	-5.9166
	10.0%	-6.7081
	2.5%	-7.6009
	0.5%	-7.6009
minimum	0.0%	-7.6009

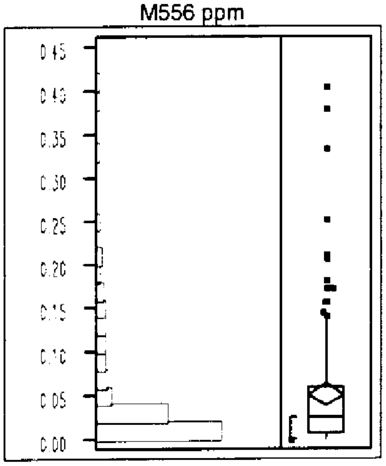
Moments

Mean	-4.3545
Std Dev	1.9010
Std Error Mean	0.1694
Upper 95% Mean	-4.0193
Lower 95% Mean	-4.6896
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.946788	0.0002

Chemical Plant
Random Sample
M556 ppm



	Quantiles	
maximum	100.0%	0.40600
	99.5%	0.40600
	97.5%	0.32165
	90.0%	0.15000
quartile	75.0%	0.05995
median	50.0%	0.02615
quartile	25.0%	0.00765
	10.0%	0.00300
	2.5%	0.00175
	0.5%	0.00140
minimum	0.0%	0.00140

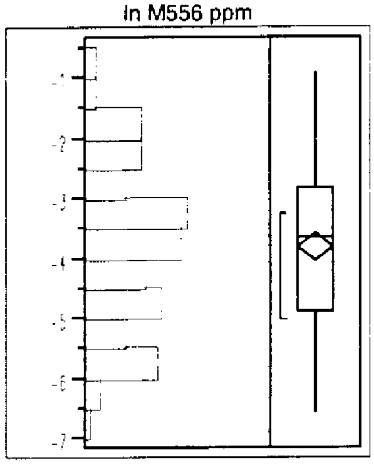
Moments	
Mean	0.0519
Std Dev	0.0737
Std Error Mean	0.0066
Upper 95% Mean	0.0649
Lower 95% Mean	0.0389
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.671484	0.0000

 3MA10050538

Chemical Plant
Random Sample
ln M556 ppm



Quantiles		
maximum	100.0%	-0.9014
	99.5%	-0.9014
	97.5%	-1.1396
	90.0%	-1.8976
quartile	75.0%	-2.8151
median	50.0%	-3.6443
quartile	25.0%	-4.8731
	10.0%	-5.8091
	2.5%	-6.3487
	0.5%	-6.5713
minimum	0.0%	-6.5713

Moments	
Mean	-3.7960
Std Dev	1.3638
Std Error Mean	0.1215
Upper 95% Mean	-3.5556
Lower 95% Mean	-4.0365
N	126.0000
Sum Weights	126.0000

Test for Normality
Shapiro-Wilk W Test

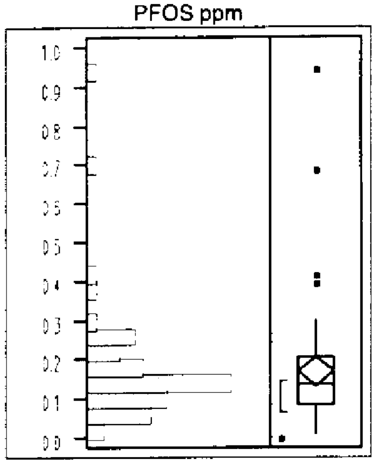
W	Prob<W
0.962731	0.0158

Appendix D

Distribution of Fluorochemicals and Their Natural Log Transformation
Among Film Plant Employees (N = 60) in the Random Sample

Film Plant
Random Sample

PFOS ppm



Quantiles

maximum	100.0%	0.94600
	99.5%	0.94600
	97.5%	0.81265
	90.0%	0.27350
quartile	75.0%	0.20825
median	50.0%	0.13750
quartile	25.0%	0.08698
	10.0%	0.06720
	2.5%	0.02393
	0.5%	0.01500
minimum	0.0%	0.01500

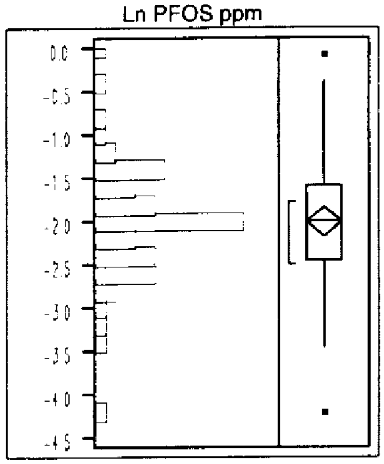
Moments

Mean	0.17181
Std Dev	0.14780
Std Error Mean	0.01908
Upper 95% Mean	0.20999
Lower 95% Mean	0.13363
N	60.00000
Sum Weights	60.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.682603	<.0001

Film Plant
Random Sample
Ln PFOS ppm



Quantiles

maximum	100.0%	-0.0555
	99.5%	-0.0555
	97.5%	-0.2197
	90.0%	-1.2965
quartile	75.0%	-1.5712
median	50.0%	-1.9841
quartile	25.0%	-2.4421
	10.0%	-2.7002
	2.5%	-3.8019
	0.5%	-4.1997
minimum	0.0%	-4.1997

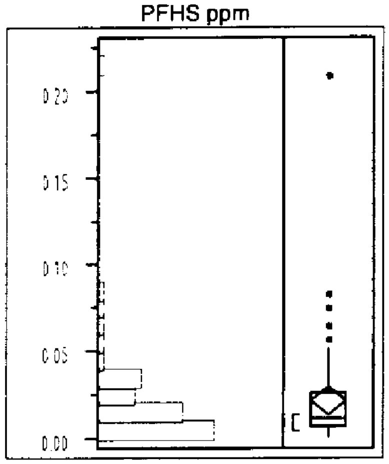
Moments

Mean	-1.99622
Std Dev	0.67992
Std Error Mean	0.08778
Upper 95% Mean	-1.82058
Lower 95% Mean	-2.17187
N	60.00000
Sum Weights	60.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.975227	0.4827

Film Plant
Random Sample
PFHS ppm



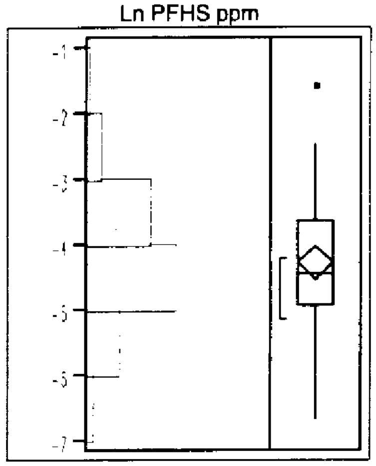
Quantiles		
maximum	100.0%	0.21000
	99.5%	0.21000
	97.5%	0.14670
	90.0%	0.04660
quartile	75.0%	0.02660
median	50.0%	0.01190
quartile	25.0%	0.00718
	10.0%	0.00565
	2.5%	0.00131
	0.5%	0.00131
minimum	0.0%	0.00131

Moments	
Mean	0.02258
Std Dev	0.03053
Std Error Mean	0.00397
Upper 95% Mean	0.03053
Lower 95% Mean	0.01462
N	59.00000
Sum Weights	59.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.578079	0.0000

Film Plant
Random Sample
Ln PFHS ppm



Quantiles

maximum	100.0%	-1.5606
	99.5%	-1.5606
	97.5%	-2.0224
	90.0%	-3.0662
quartile	75.0%	-3.6268
median	50.0%	-4.4312
quartile	25.0%	-4.9365
	10.0%	-5.1761
	2.5%	-6.6377
	0.5%	-6.6377
minimum	0.0%	-6.6377

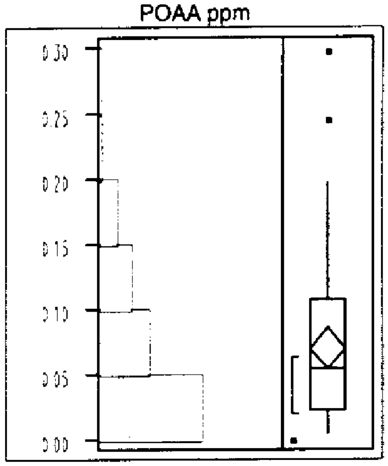
Moments

Mean	-4.26780
Std Dev	0.95250
Std Error Mean	0.12401
Upper 95% Mean	-4.01958
Lower 95% Mean	-4.51602
N	59.00000
Sum Weights	59.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.977452	0.5773

Film Plant
Random Sample
POAA ppm



Quantiles

maximum	100.0%	0.29800
	99.5%	0.29800
	97.5%	0.27200
	90.0%	0.15400
quartile	75.0%	0.10800
median	50.0%	0.05520
quartile	25.0%	0.02400
	10.0%	0.01560
	2.5%	0.00651
	0.5%	0.00598
minimum	0.0%	0.00598

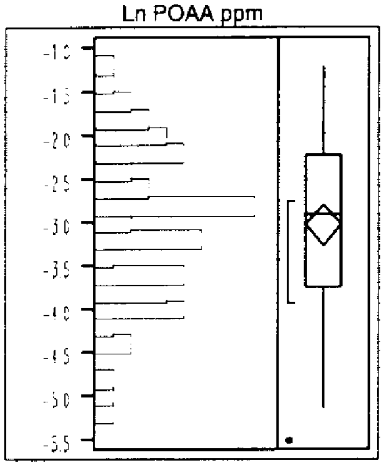
Moments

Mean	0.07084
Std Dev	0.06200
Std Error Mean	0.00807
Upper 95% Mean	0.08700
Lower 95% Mean	0.05469
N	59.00000
Sum Weights	59.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.843094	<.0001

Film Plant
Random Sample
Ln POAA ppm



Quantiles

maximum	100.0%	-1.2107
	99.5%	-1.2107
	97.5%	-1.3065
	90.0%	-1.8708
quartile	75.0%	-2.2256
median	50.0%	-2.8968
quartile	25.0%	-3.7297
	10.0%	-4.1605
	2.5%	-5.0377
	0.5%	-5.1193
minimum	0.0%	-5.1193

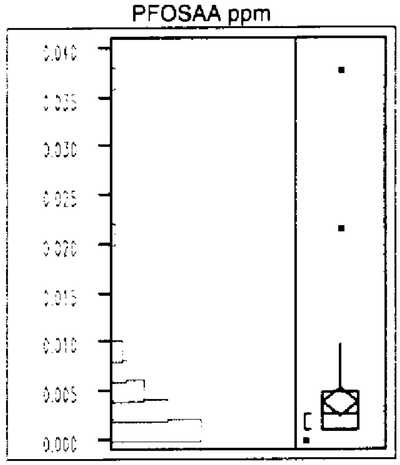
Moments

Mean	-3.02097
Std Dev	0.91335
Std Error Mean	0.11891
Upper 95% Mean	-2.78295
Lower 95% Mean	-3.25899
N	59.00000
Sum Weights	59.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.975823	0.5122

Film Plant
Random Sample
PFOSAA ppm



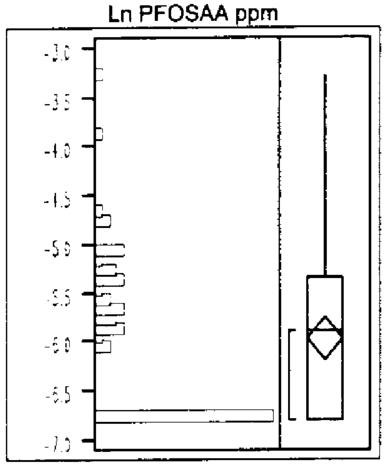
	Quantiles	
maximum	100.0%	0.03780
	99.5%	0.03780
	97.5%	0.02975
	90.0%	0.00635
quartile	75.0%	0.00487
median	50.0%	0.00280
quartile	25.0%	0.00112
	10.0%	0.00112
	2.5%	0.00112
	0.5%	0.00112
minimum	0.0%	0.00112

Moments	
Mean	0.00397
Std Dev	0.00554
Std Error Mean	0.00072
Upper 95% Mean	0.00542
Lower 95% Mean	0.00253
N	59.00000
Sum Weights	59.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.511689	0.0000

Film Plant
Random Sample
Ln PFOSAA ppm



Quantiles

maximum	100.0%	-3.2754
	99.5%	-3.2754
	97.5%	-3.5529
	90.0%	-5.0593
quartile	75.0%	-5.3247
median	50.0%	-5.8781
quartile	25.0%	-6.7944
	10.0%	-6.7944
	2.5%	-6.7944
	0.5%	-6.7944
minimum	0.0%	-6.7944

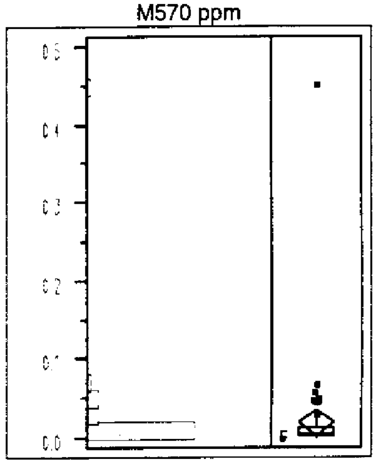
Moments

Mean	-5.95844
Std Dev	0.84775
Std Error Mean	0.11037
Upper 95% Mean	-5.73751
Lower 95% Mean	-6.17936
N	59.00000
Sum Weights	59.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.843132	<.0001

Film Plant
Random Sample
M570 ppm



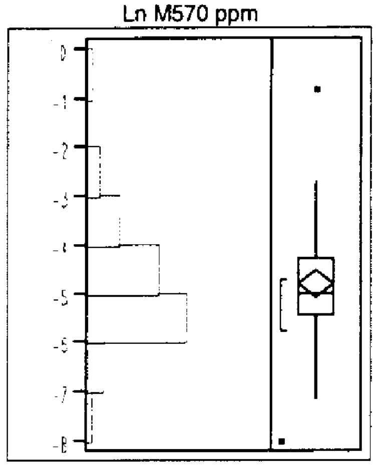
Quantiles		
maximum	100.0%	0.45400
	99.5%	0.45400
	97.5%	0.25193
	90.0%	0.04805
quartile	75.0%	0.01420
median	50.0%	0.00690
quartile	25.0%	0.00432
	10.0%	0.00251
	2.5%	0.00112
	0.5%	0.00080
minimum	0.0%	0.00080

Moments	
Mean	0.02024
Std Dev	0.05901
Std Error Mean	0.00762
Upper 95% Mean	0.03548
Lower 95% Mean	0.00499
N	60.00000
Sum Weights	60.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.293209	0.0000

Film Plant
Random Sample
Ln M570 ppm



Quantiles

maximum	100.0%	-0.7897
	99.5%	-0.7897
	97.5%	-1.7780
	90.0%	-3.0356
quartile	75.0%	-4.2546
median	50.0%	-4.9779
quartile	25.0%	-5.4434
	10.0%	-5.9875
	2.5%	-6.8371
	0.5%	-7.1309
minimum	0.0%	-7.1309

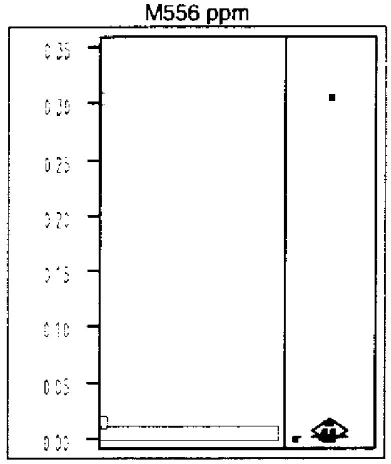
Moments

Mean	-4.79892
Std Dev	1.10619
Std Error Mean	0.14281
Upper 95% Mean	-4.51316
Lower 95% Mean	-5.08467
N	60.00000
Sum Weights	60.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.948604	0.0263

Film Plant
Random Sample
M556 ppm



Quantiles

maximum	100.0%	0.30700
	99.5%	0.30700
	97.5%	0.15407
	90.0%	0.00593
quartile	75.0%	0.00250
median	50.0%	0.00250
quartile	25.0%	0.00250
	10.0%	0.00117
	2.5%	0.00021
	0.5%	0.00010
minimum	0.0%	0.00010

Moments

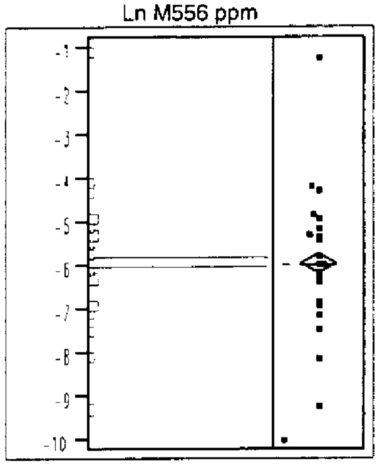
Mean	0.00816
Std Dev	0.03932
Std Error Mean	0.00508
Upper 95% Mean	0.01832
Lower 95% Mean	-0.00200
N	60.00000
Sum Weights	60.00000

Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.162266	0.0000

 3MA10050551

Film Plant
Random Sample
Ln M556 ppm



Quantiles

maximum	100.0%	-1.1809
	99.5%	-1.1809
	97.5%	-2.7418
	90.0%	-5.1284
quartile	75.0%	-5.9915
median	50.0%	-5.9915
quartile	25.0%	-5.9915
	10.0%	-6.7632
	2.5%	-8.6336
	0.5%	-9.2103
minimum	0.0%	-9.2103

Moments

Mean	-5.93097
Std Dev	0.95792
Std Error Mean	0.12367
Upper 95% Mean	-5.68351
Lower 95% Mean	-6.17842
N	60.00000
Sum Weights	60.00000

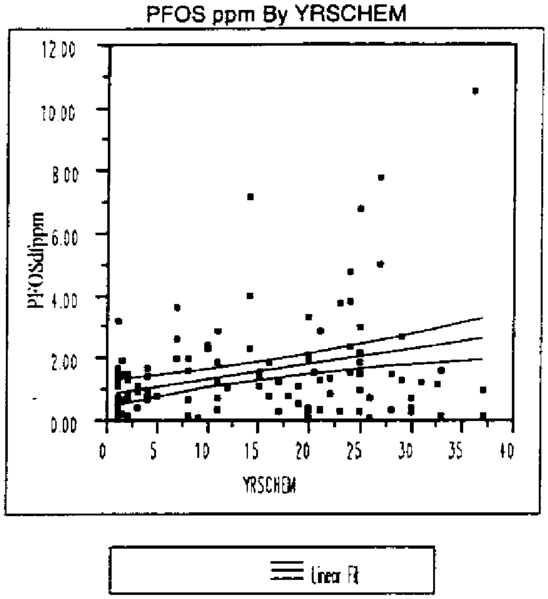
Test for Normality
Shapiro-Wilk W Test

W	Prob<W
0.682874	<.0001

Appendix E

Scatterplots and regression equations for fluorochemicals by years worked in chemical (YRSCHEM) for random sample (n = 126) and for current job cateogries (chemical operators, engineer/lab, maintenance, supervisor/mgmt and mill operators)

Random Sample
PFOS ppm By YRSCHEM



Linear Fit
PFOSdfppm = 0.89178 + 0.0478 YRSCHEM

Summary of Fit

RSquare	0.10808
RSquare Adj	0.100887
Root Mean Square Error	1.528756
Mean of Response	1.504686
Observations (or Sum Wgts)	126

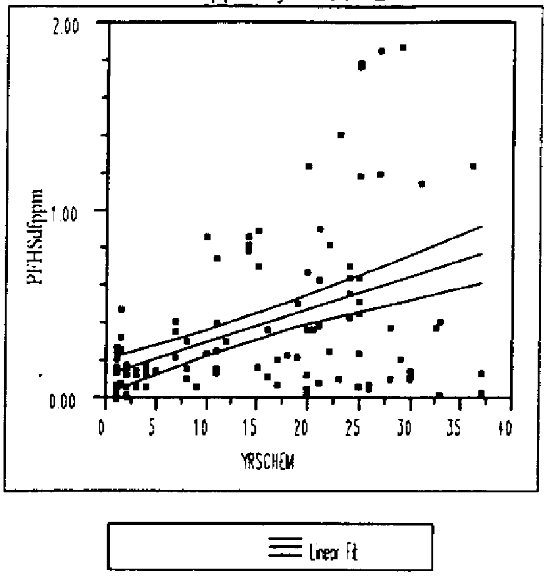
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	35.11712	35.1171	15.0260
Error	124	289.79964	2.3371	Prob>F
C Total	125	324.91676		0.0002

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.8917838	0.208682	4.27	<.0001	0.4787397	1.3048279
YRSCHEM	0.0478029	0.012332	3.88	0.0002	0.0233943	0.0722116

Random Sample
PFHS ppm By YRSCHEM



Linear Fit

PFHSdfppm = 0.11968 + 0.01757 YRSCHEM

Summary of Fit

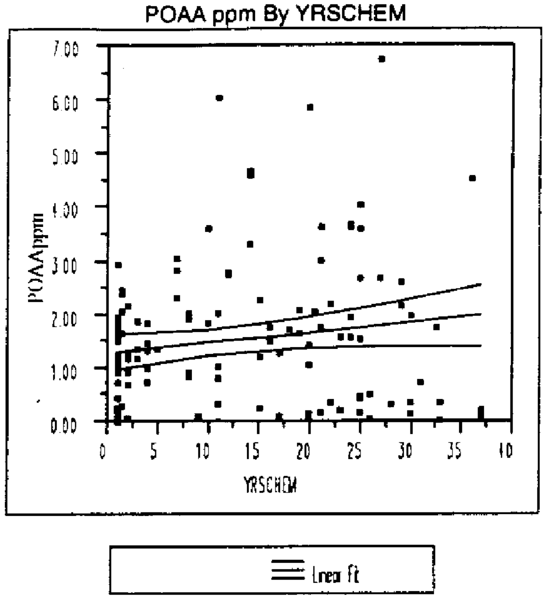
RSquare	0.223991
RSquare Adj	0.217733
Root Mean Square Error	0.364103
Mean of Response	0.344977
Observations (or Sum Wgts)	126

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.744959	4.74496	35.7919
Error	124	16.438777	0.13257	Prob>F
C Total	125	21.183736		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1196844	0.049702	2.41	0.0175	0.02131	0.2180589
YRSCHEM	0.0175716	0.002937	5.98	<.0001	0.0117582	0.023385



Linear Fit

POAAppm = 1.29399 + 0.0189 YRSCHEM

Summary of Fit

RSquare	0.0246
RSquare Adj	0.016734
Root Mean Square Error	1.324636
Mean of Response	1.536271
Observations (or Sum Wgts)	126

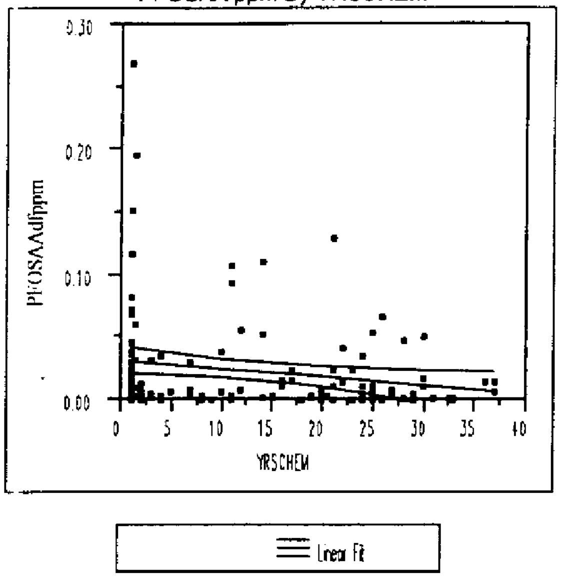
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	5.48740	5.48740	3.1273
Error	124	217.57785	1.75466	Prob>F
C Total	125	223.06524		0.0794

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.2939922	0.180819	7.16	<.0001	0.9360979	1.6518866
YRSCHEM	0.0188964	0.010685	1.77	0.0794	-0.002253	0.040046

Random Sample
PFOSAA ppm By YRSCHEM



Linear Fit

PFOSAAdfppm = 0.03213 – 0.00069 YRSCHEM

Summary of Fit

RSquare	0.0373
RSquare Adj	0.029536
Root Mean Square Error	0.03898
Mean of Response	0.023293
Observations (or Sum Wgts)	126

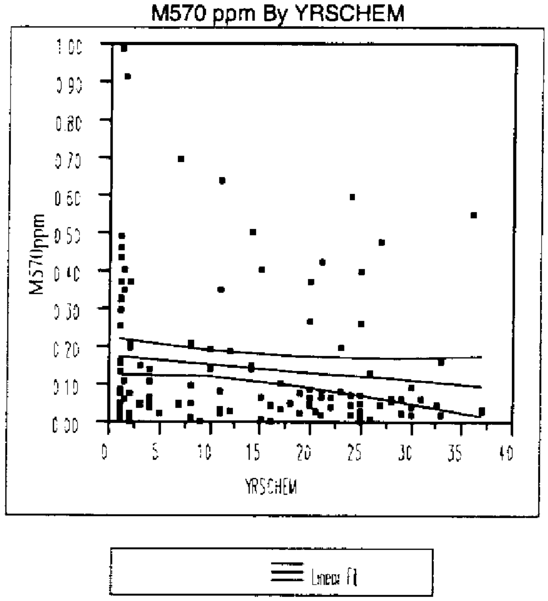
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00729999	0.007300	4.8044
Error	124	0.18840938	0.001519	Prob>F
C Total	125	0.19570936		0.0303

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0321302	0.005321	6.04	<.0001	0.0215985	0.0426619
YRSCHEM	-0.000689	0.000314	-2.19	0.0303	-0.001312	-0.000067

Random Sample
M570 ppm By YRSCHEM



Linear Fit
M570ppm = 0.1791 – 0.00223 YRSCHEM

Summary of Fit

RSquare	0.017688
RSquare Adj	0.009766
Root Mean Square Error	0.185242
Mean of Response	0.150471
Observations (or Sum Wgts)	126

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0766188	0.076619	2.2328
Error	124	4.2550321	0.034315	Prob>F
C Total	125	4.3316509		0.1376

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1791	0.025286	7.08	<.0001	0.1290506	0.2291494
YRSCHEM	-0.002233	0.001494	-1.49	0.1376	0.005191	0.0007248

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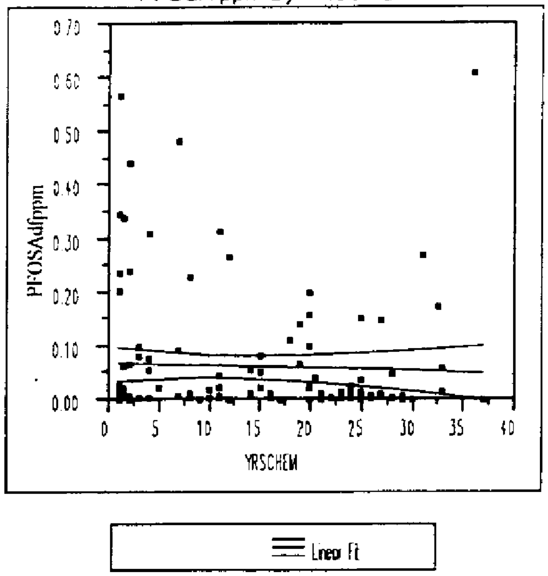
Random Sample
PFOSA ppm By YRSCHEM



Linear Fit

PFOSAdfppm = 0.06731 – 0.00043 YRSCHEM

Summary of Fit

RSquare	0.001675
RSquare Adj	-0.00638
Root Mean Square Error	0.116893
Mean of Response	0.061792
Observations (or Sum Wgts)	126

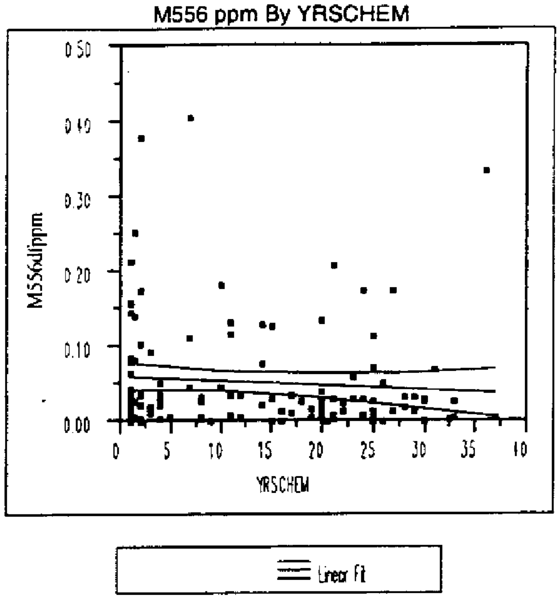
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0028424	0.002842	0.2080
Error	124	1.6943378	0.013664	Prob>F
C Total	125	1.6971802		0.6491

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0673064	0.015956	4.22	<.0001	0.0357238	0.0988889
YRSCHEM	-0.00043	0.000943	-0.46	0.6491	-0.002296	0.0014363

Random Sample
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = 0.05953 - 0.00059 YRSCHEM

Summary of Fit

RSquare	0.007918
RSquare Adj	-0.00008
Root Mean Square Error	0.073716
Mean of Response	0.051941
Observations (or Sum Wgts)	126

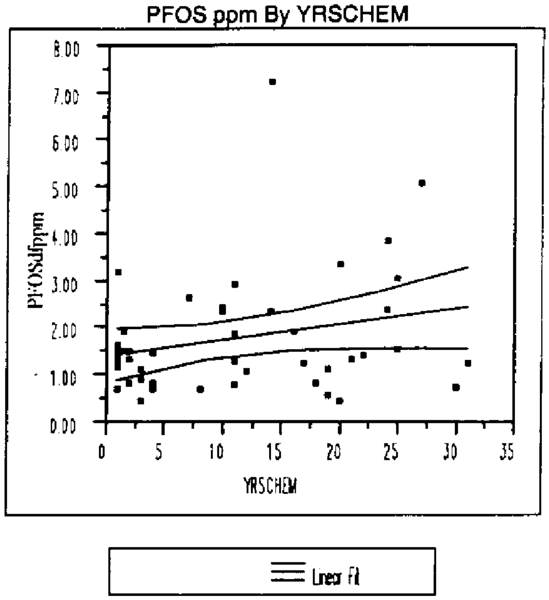
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00537776	0.005378	0.9896
Error	124	0.67382941	0.005434	Prob>F
C Total	125	0.67920717		0.3218

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0595259	0.010063	5.92	<.0001	0.0396089	0.0794428
YRSCHEM	-0.000592	0.000595	-0.99	0.3218	-0.001769	0.0005854

Random Sample
Chemical Operators
PFOS ppm By YRSCHEM



Linear Fit
PFOSdfppm = 1.41646 + 0.03312 YRSCHEM
Summary of Fit

RSquare	0.060486
RSquare Adj	0.039608
Root Mean Square Error	1.237904
Mean of Response	1.781106
Observations (or Sum Wgts)	47

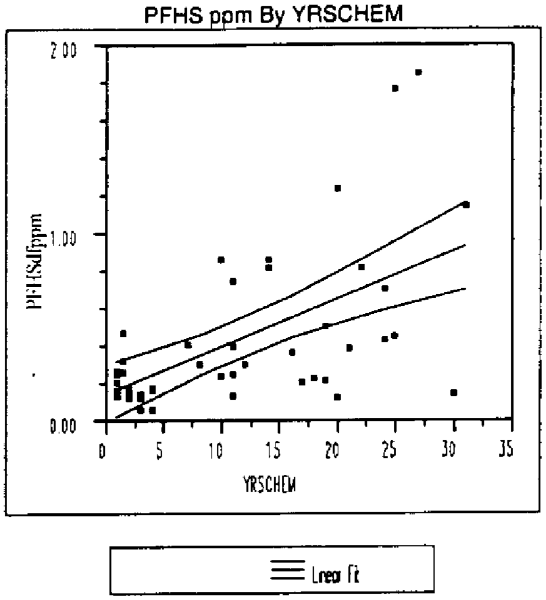
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.439524	4.43952	2.8971
Error	45	68.958297	1.53241	Prob>F
C Total	46	73.397820		0.0956

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.4164581	0.280181	5.06	<.0001	0.8521458	1.9807704
YRSCHEM	0.0331178	0.019457	1.70	0.0956	-0.006071	0.0723065

Random Sample
Chemical Operators
PFHS ppm By YRSCHEM



Linear Fit

PFHSdfppm = 0.14813 + 0.0254 YRSCHEM

Summary of Fit

RSquare	0.342256
RSquare Adj	0.32764
Root Mean Square Error	0.333897
Mean of Response	0.427751
Observations (or Sum Wgts)	47

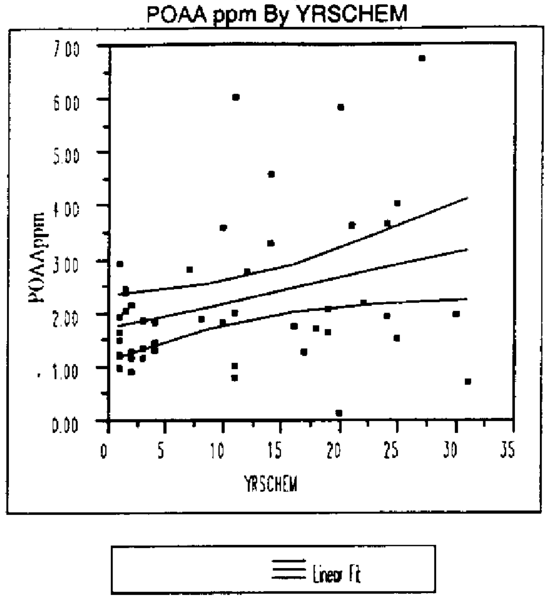
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.6105444	2.61054	23.4157
Error	45	5.0169158	0.11149	Prob>F
C Total	46	7.6274602		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.148129	0.075573	1.96	0.0562	-0.004082	0.3003395
YRSCHEM	0.0253956	0.005248	4.84	<.0001	0.0148254	0.0359659

Random Sample
Chemical Operators
POAA ppm By YRSCHEM



Linear Fit
POAAppm = 1.73387 + 0.04702 YRSCHEM

Summary of Fit

RSquare	0.09937
RSquare Adj	0.079356
Root Mean Square Error	1.342508
Mean of Response	2.251574
Observations (or Sum Wgts)	47

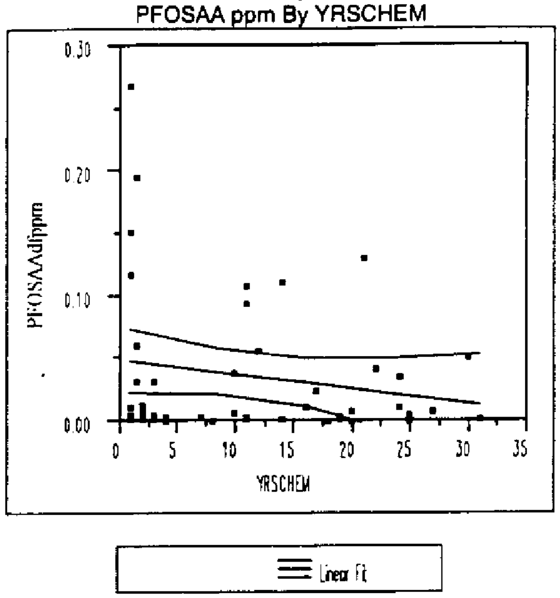
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	8.948633	8.94863	4.9650
Error	45	81.104760	1.80233	Prob>F
C Total	46	90.053393		0.0309

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.7338672	0.303857	5.71	<.0001	1.12187	2.3458643
YRSCHEM	0.0470188	0.021101	2.23	0.0309	0.0045187	0.089519

Random Sample
Chemical Operators
PFOSAA ppm By YRSCHEM



Linear Fit
PFOSAAdfppm = 0.0494 – 0.00118 YRSCHEM

Summary of Fit

RSquare	0.03628
RSquare Adj	0.014864
Root Mean Square Error	0.057519
Mean of Response	0.036447
Observations (or Sum Wgts)	47

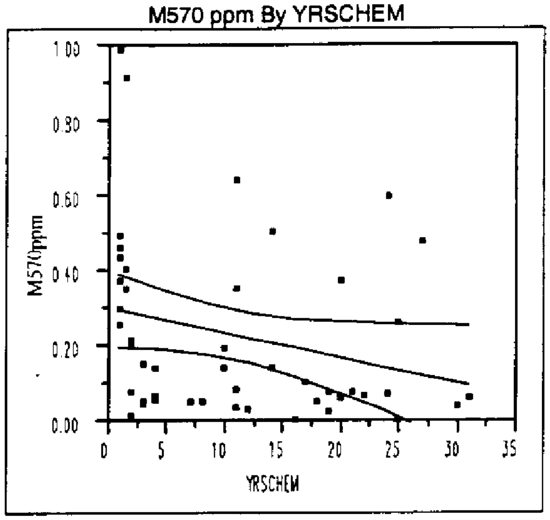
Analysis of Variance

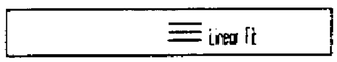
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00560458	0.005605	1.6940
Error	45	0.14887811	0.003308	Prob>F
C Total	46	0.15448269		0.1997

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0494028	0.013019	3.79	0.0004	0.0231822	0.0756233
YRSCHEM	-0.001177	0.000904	-1.30	0.1997	-0.002998	0.0006442

Random Sample
Chemical Operators
M570 ppm By YRSCHEM





Linear Fit

M570ppm = 0.30244 – 0.00666 YRSCHEM

Summary of Fit

RSquare	0.071071
RSquare Adj	0.050428
Root Mean Square Error	0.228431
Mean of Response	0.229083
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.1796529	0.179653	3.4429
Error	45	2.3481307	0.052181	Prob>F
C Total	46	2.5277836		0.0701

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3024368	0.051702	5.85	<.0001	0.1983041	0.4065696
YRSCHEM	-0.006662	0.00359	-1.86	0.0701	-0.013894	0.0005694

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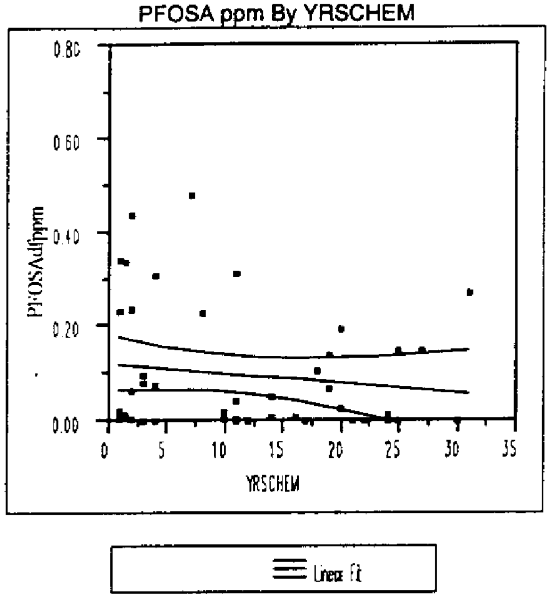
Random Sample
Chemical Operators
PFOSA ppm By YRSCHEM



Linear Fit
PFOSAdfppm = 0.12291 – 0.00214 YRSCHEM

Summary of Fit

RSquare	0.023165
RSquare Adj	0.001457
Root Mean Square Error	0.1315[illegible]3
Mean of Response	0.099399
Observations (or Sum Wgts)	47

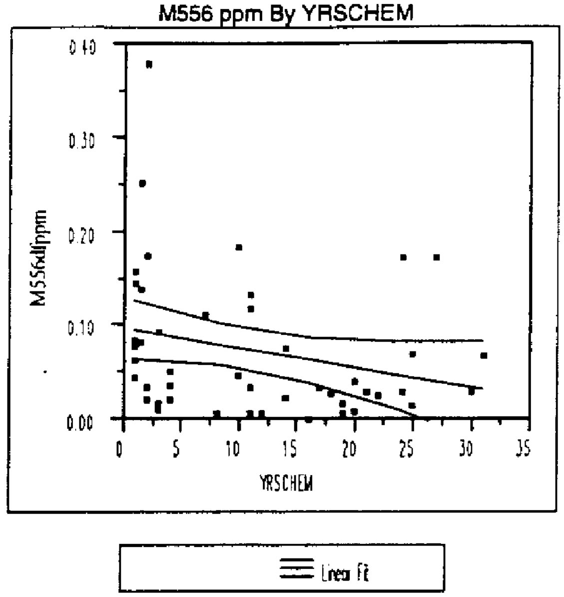
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01845661	0.018457	1.0671
Error	45	0.77830020	0.017296	Prob>F
C Total	46	0.79675681		0.3071

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1229105	0.029766	4.13	0.0002	0.0629591	0.182862
YRSCHEM	-0.002135	0.002067	-1.03	0.3071	-0.006299	0.002028

Random Sample
Chemical Operators
M556 ppm By YRSCHEM



Linear Fit
M556dfppm = 0.09775 – 0.00212 YRSCHEM

Summary of Fit

RSquare	0.069465
RSquare Adj	0.048786
Root Mean Square Error	0.073484
Mean of Response	0.074438
Observations (or Sum Wgts)	47

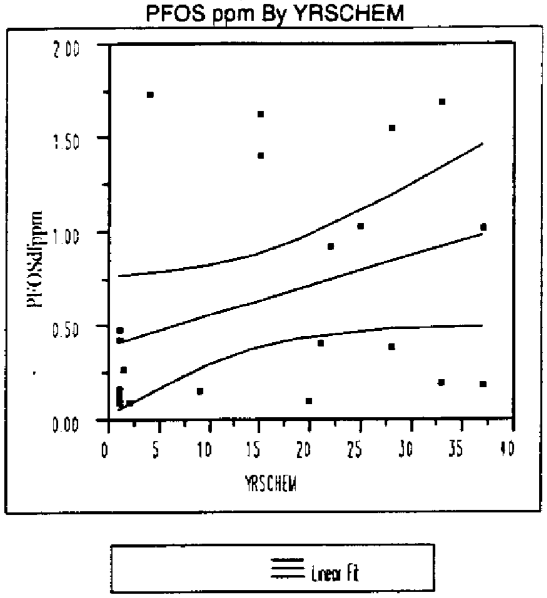
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01813944	0.018139	3.3593
Error	45	0.24299278	0.005400	Prob>F
C Total	46	0.26113221		0.0734

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.097747	0.016632	5.88	<.0001	0.0642487	0.1312453
YRSCHEM	-0.002117	0.001155	-1.83	0.0734	-0.004443	0.0002094

Random Sample
Engineer/Lab
PFOS ppm By YRSCHEM



Linear Fit

PFOSdfppm = 0.40446 + 0.01564 YRSCHEM

Summary of Fit

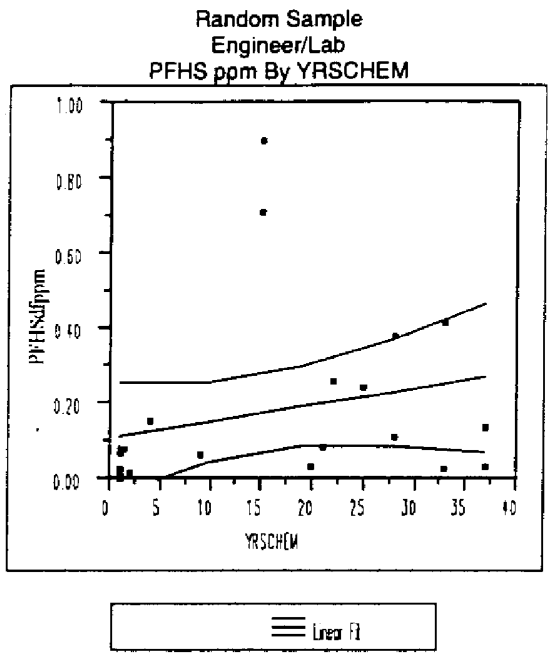
RSquare	0.124933
RSquare Adj	0.083263
Root Mean Square Error	0.574244
Mean of Response	0.633961
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.9886669	0.988667	2.9982
Error	21	6.9248903	0.329757	Prob>F
C Total	22	7.9135572		0.0980

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.4044606	0.178619	2.26	0.0343	0.0330049	0.7759163
YRSCHEM	0.01564	0.009033	1.73	0.0980	-0.003144	0.034424



Linear Fit

PFHSdfppm = 0.10657 + 0.00439 YRSCHEM

Summary of Fit

RSquare	0.065012
RSquare Adj	0.020489
Root Mean Square Error	0.23077
Mean of Response	0.170983
Observations (or Sum Wgts)	23

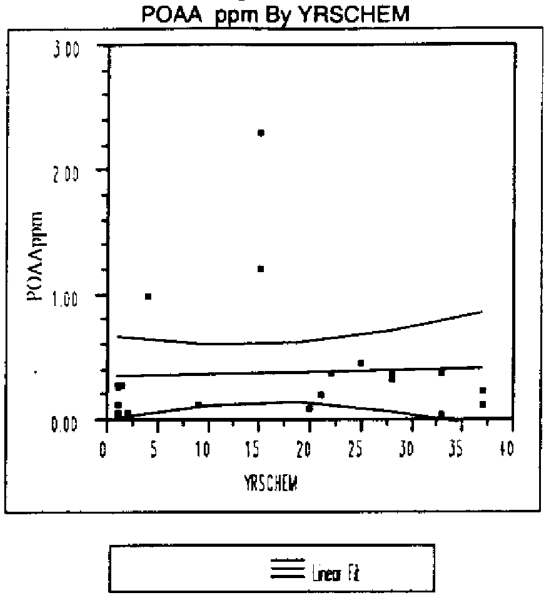
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0777620	0.077762	1.4602
Error	21	1.1183544	0.053255	Prob>F
C Total	22	1.1961164		0.2403

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1065696	0.071781	1.48	0.1525	-0.042706	0.2558458
YRSCHEM	0.0043863	0.00363	1.21	0.2403	-0.003162	0.011935

Random Sample
Engineer/Lab
POAA ppm By YRSCHEM



Linear Fit

POAAppm = 0.34907 + 0.00185 YRSCHEM

Summary of Fit

RSquare	0.002389
RSquare Adj	-0.04512
Root Mean Square Error	0.525717
Mean of Response	0.376278
Observations (or Sum Wgts)	23

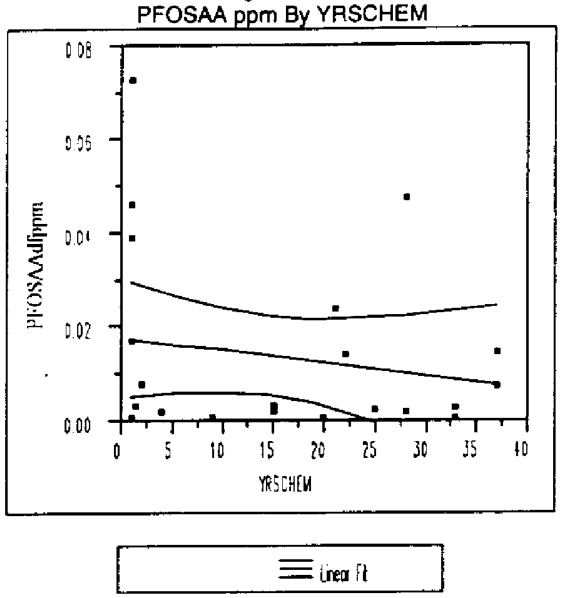
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0138962	0.013896	0.0503
Error	21	5.8039396	0.276378	Prob>F
C Total	22	5.8178358		0.8247

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3490696	0.163524	2.13	0.0447	0.0090046	0.6891347
YRSCHEM	0.0018542	0.008269	0.22	0.8247	-0.015342	0.0190509

Random Sample
Engineer/Lab
PFOSAA ppm By YRSCHEM



Linear Fit
PFOSAAdfppm = 0.01789 – 0.00027 YRSCHEM

Summary of Fit

RSquare	0.034722
RSquare Adj	-0.01124
Root Mean Square Error	0.019647
Mean of Response	0.013949
Observations (or Sum Wgts)	23

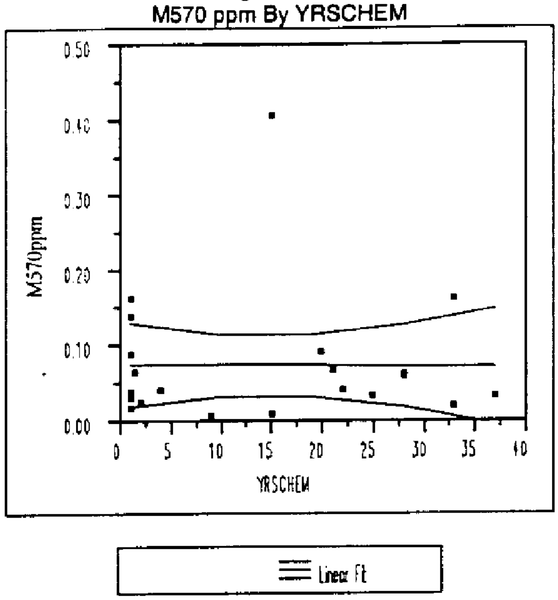
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00029158	0.000292	0.7554
Error	21	0.00810598	0.000386	Prob>F
C Total	22	0.00839755		0.3946

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0178899	0.006111	2.93	0.0080	0.0051812	0.0305987
YRSCHEM	-0.000269	0.000309	-0.87	0.3946	-0.000911	0.0003741

Random Sample
Engineer/Lab
M570 ppm By YRSCHEM



Linear Fit

M570ppm = 0.0747 – 0.00004 YRSCHEM

Summary of Fit

RSquare	0.000047
RSquare Adj	-0.04757
Root Mean Square Error	0.087863
Mean of Response	0.074065
Observations (or Sum Wgts)	23

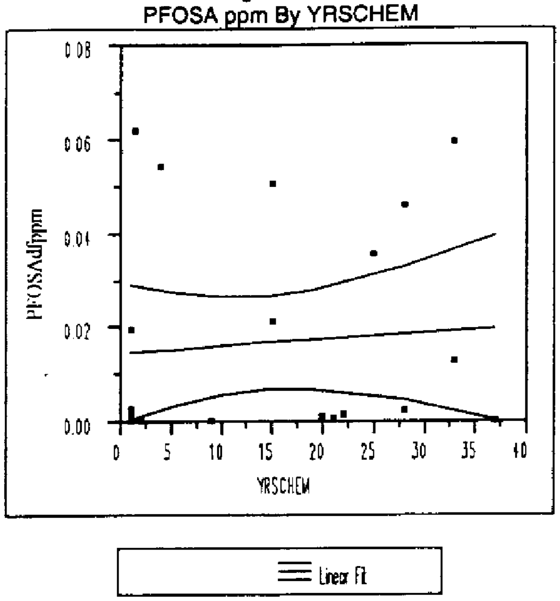
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00000754	0.000008	0.0010
Error	21	0.16211665	0.007720	Prob>F
C Total	22	0.16212419		0.9754

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0746991	0.02733	2.73	0.0125	0.0178643	0.131534
YRSCHEM	-0.000043	0.001382	-0.03	0.9754	-0.002917	0.0028309

Random Sample
Engineer/Lab
PFOSA ppm By YRSCHEM



Linear Fit
PFOSAdfppm = 0.01475 + 0.00015 YRSCHEM

Summary of Fit

RSquare	0.007656
RSquare Adj	-0.0396
Root Mean Square Error	0.023047
Mean of Response	0.01689
Observations (or Sum Wgts)	23

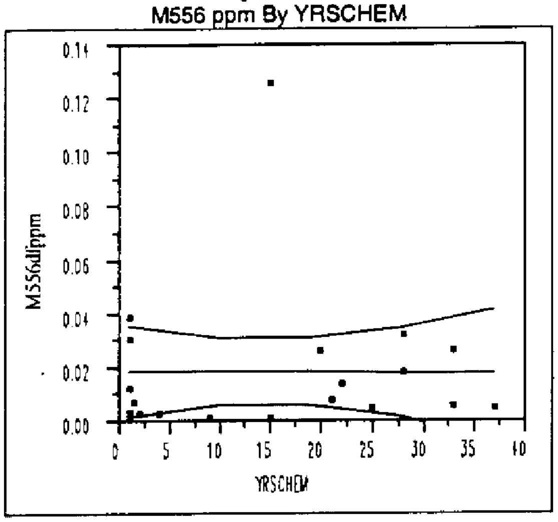
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00008605	0.000086	0.1620
Error	21	0.01115404	0.000531	Prob>F
C Total	22	0.01124009		0.6914

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0147485	0.007169	2.06	0.0523	-0.000159	0.0296564
YRSCHEM	0.0001459	0.000363	0.40	0.6914	-0.000608	0.0008998

Random Sample
Engineer/Lab
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = 0.0188 – 0.00001 YRSCHEM

Summary of Fit

RSquare	0.000046
RSquare Adj	-0.04757
Root Mean Square Error	0.027423
Mean of Response	0.0186
Observations (or Sum Wgts)	23

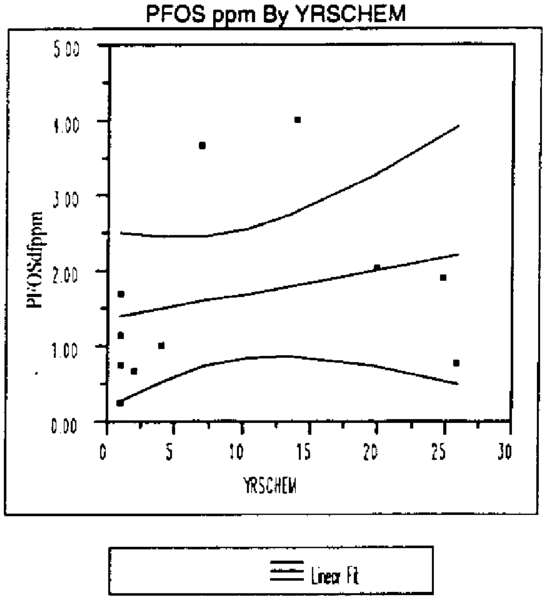
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00000073	0.000001	0.0010
Error	21	0.01579191	0.000752	Prob>F
C Total	22	0.01579264		0.9754

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0187973	0.00853	2.20	0.0388	0.0010588	0.0365359
YRSCHEM	-0.000013	0.000431	-0.03	0.9754	-0.00091	0.0008836

Random Sample
Maintenance
PFOS ppm By YRSCHEM



Linear Fit

PFOSdfppm = 1.36713 + 0.03289 YRSCHEM

Summary of Fit

RSquare	0.073544
RSquare Adj	-0.0294
Root Mean Square Error	1.245224
Mean of Response	1.672091
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.107805	1.10780	0.7144
Error	9	13.955256	1.55058	Prob>F
C Total	10	15.063061		0.4199

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.3671255	0.52071	2.63	0.0276	0.1891877	2.5450633
YRSCHEM	0.0328884	0.03891	0.85	0.4199	-0.055132	0.1209093

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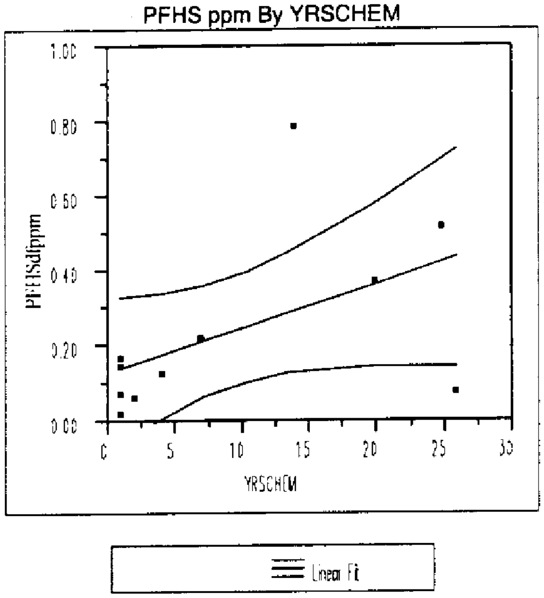
Random Sample
Maintenance
PFHS ppm By YRSCHEM



Linear Fit

PFHSdfppm = 0.1267 + 0.01194 YRSCHEM

Summary of Fit

RSquare	0.261552
RSquare Adj	0.179502
Root Mean Square Error	0.214098
Mean of Response	0.237455
Observations (or Sum Wgts)	11

Analysis of Variance

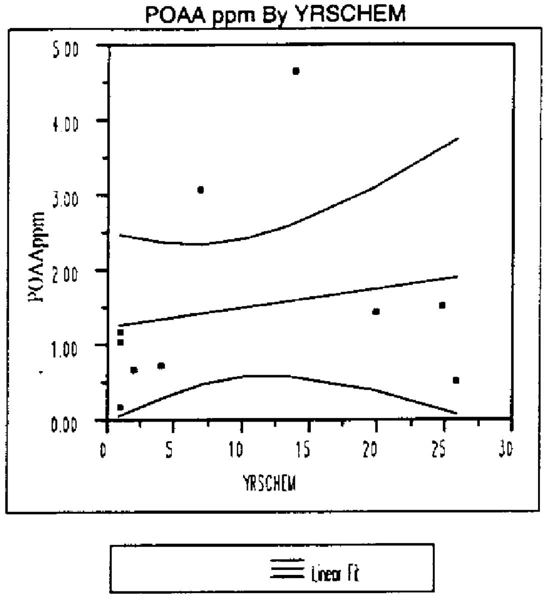
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.14611866	0.146119	3.1877
Error	9	0.41254111	0.045838	Prob>F
C Total	10	0.55865977		0.1078

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1266974	0.089528	1.42	0.1907	-0.075832	0.3292263
YRSCHEM	0.0119444	0.00669	1.79	0.1078	-0.003189	0.0270783

 3MA10050576

Random Sample
Maintenance
POAA ppm By YRSCHEM



Linear Fit
POAAppm = 1.24651 + 0.02555 YRSCHEM

Summary of Fit

RSquare	0.039706
RSquare Adj	-0.06699
Root Mean Square Error	1.340539
Mean of Response	1.483455
Observations (or Sum Wgts)	11

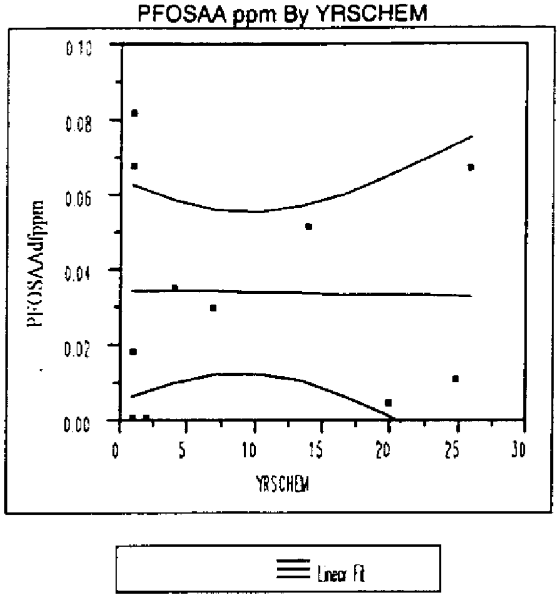
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.668731	0.66873	0.3721
Error	9	16.173404	1.79704	Prob>F
C Total	10	16.842135		0.5569

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.2465111	0.560567	2.22	0.0532	-0.021591	2.514613
YRSCHEM	0.0255527	0.041888	0.61	0.5569	-0.069206	0.1203111

Random Sample
Maintenance
PFOSAA ppm By YRSCHEM



Linear Fit
PFOSAAdfppm = 0.0347 – 0.00006 YRSCHEM

Summary of Fit

RSquare	0.00047:
RSquare Adj	-0.1105
Root Mean Square Error	0.03130
Mean of Response	0.03410
Observations (or Sum Wgts)	11

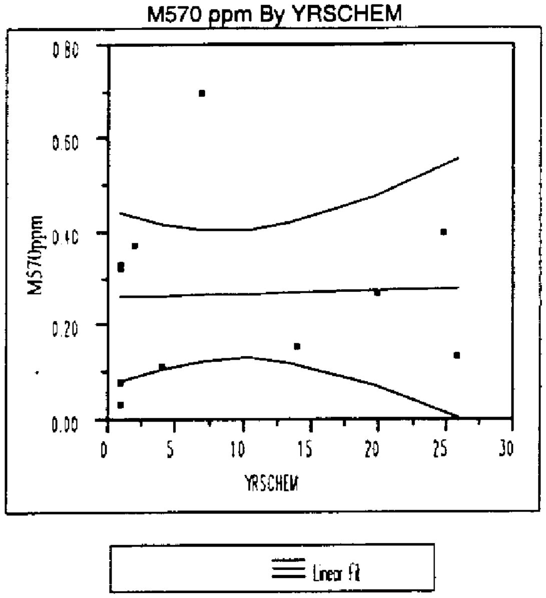
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00000416	0.000004	0.0042
Error	9	0.00881782	0.000980	Prob>F
C Total	10	0.00882198		0.9495

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0346975	0.013089	2.65	0.0264	0.0050878	0.0643072
YRSCHEM	-0.000064	0.000978	-0.07	0.9495	-0.002276	0.0021488

Random Sample
Maintenance
M570 ppm By YRSCHEM



Linear Fit

M570ppm = 0.26076 + 0.00079 YRSCHEM

Summary of Fit

RSquare	0.001749
RSquare Adj	-0.10917
Root Mean Square Error	0.201468
Mean of Response	0.268091
Observations (or Sum Wgts)	11

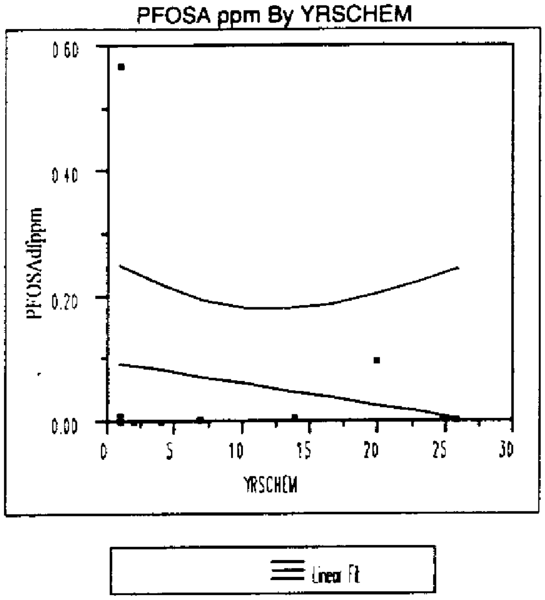
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00064018	0.000640	0.0158
Error	9	0.36530321	0.040589	Prob>F
C Total	10	0.36594339		0.9028

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.2607598	0.084247	3.10	0.0128	0.0701785	0.4513411
YRSCHEM	0.0007906	0.006295	0.13	0.9028	-0.01345	0.0150317

Random Sample
Maintenance
PFOSA ppm By YRSCHEM



Linear Fit

PFOSAdfppm = 0.09744 – 0.00351 YRSCHEM

Summary of Fit

RSquare	0.043743
RSquare Adj	-0.06251
Root Mean Square Error	0.174833
Mean of Response	0.064939
Observations (or Sum Wgts)	11

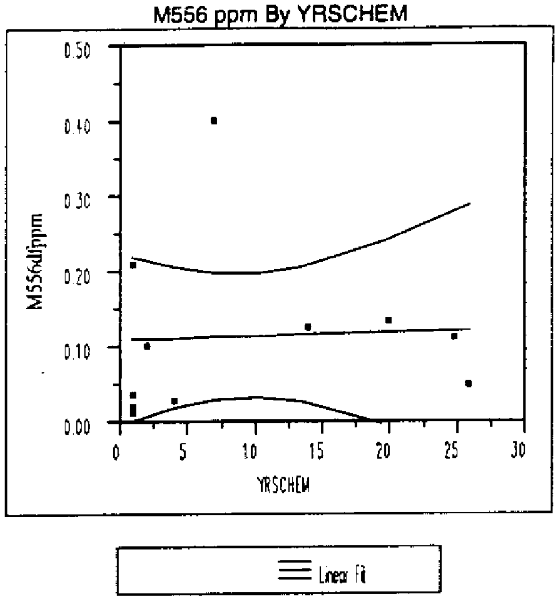
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01258420	0.012584	0.4117
Error	9	0.27509911	0.030567	Prob>F
C Total	10	0.28768331		0.5371

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0974427	0.073109	1.33	0.2153	-0.067943	0.2628285
YRSCHEM	-0.003505	0.005463	-0.64	0.5371	-0.015864	0.0088531

Random Sample
Maintenance
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = 0.11026 + 0.00048 YRSCHEM

Summary of Fit

RSquare	0.001793
RSquare Adj	-0.10912
Root Mean Square Error	0.120441
Mean of Response	0.1147
Observations (or Sum Wgts)	11

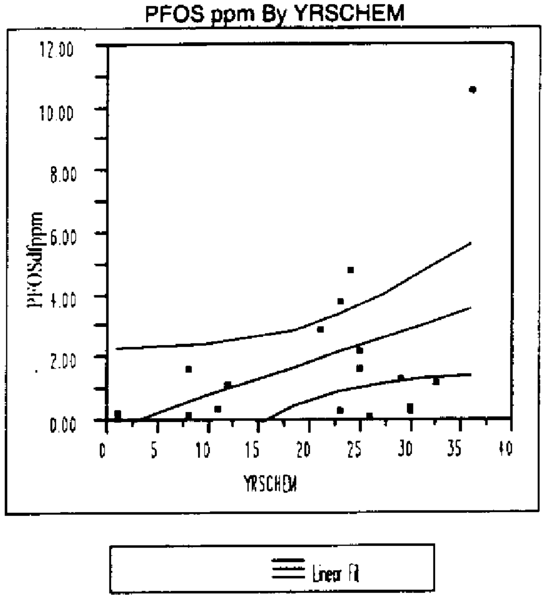
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00023453	0.000235	0.0162
Error	9	0.13055477	0.014506	Prob>F
C Total	10	0.13078930		0.9016

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1102627	0.050364	2.19	0.0563	-0.00367	0.2241958
YRSCHEM	0.0004785	0.003763	0.13	0.9016	-0.008035	0.0089921

Random Sample
Supervisor/Mgmt
PFOS ppm By YRSCHEM



Linear Fit

PFOSdfppm = -0.2688 + 0.10578 YRSCHEM

Summary of Fit

RSquare	0.19718
RSquare Adj	0.1470
Root Mean Square Error	2.36682
Mean of Response	1.87907
Observations (or Sum Wgts)	18

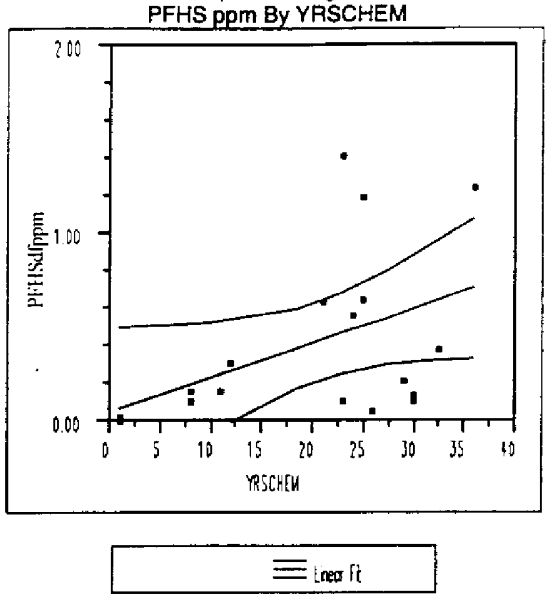
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	22.01465	22.0146	3.9299
Error	16	89.62951	5.6018	Prob>F
C Total	17	111.64416		0.0649

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.268787	1.218652	-0.22	0.8282	-2.8522	2.3146273
YRSCHEM	0.1057769	0.053358	1.98	0.0649	-0.007337	0.2188905

Random Sample
Supervisor/Mgmt
PFHS ppm By YRSCHEM



Linear Fit

PFHSdfppm = 0.04613 + 0.01835 YRSCHEM

Summary of Fit

RSquare	0.194032
RSquare Adj	0.143659
Root Mean Square Error	0.414774
Mean of Response	0.418777
Observations (or Sum Wgts)	18

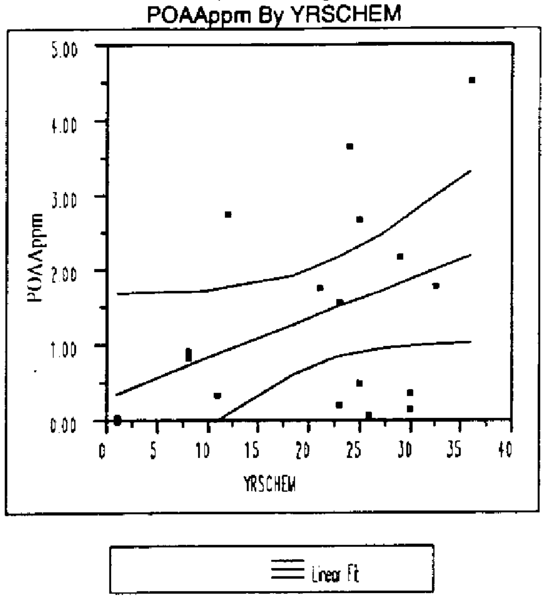
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.6626723	0.662672	3.8519
Error	16	2.7525963	0.172037	Prob>F
C Total	17	3.4152686		0.0673

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0461288	0.213563	0.22	0.8317	-0.406602	0.4988593
YRSCHEM	0.018352	0.009351	1.96	0.0673	-0.001471	0.0381746

Random Sample
Supervisor/Mgmt
POAAppm By YRSCHEM



Linear Fit

POAAppm = 0.30841 + 0.05233 YRSCHEM

Summary of Fit

RSquare	0.171838
RSquare Adj	0.120078
Root Mean Square Error	1.27387
Mean of Response	1.370928
Observations (or Sum Wgts)	18

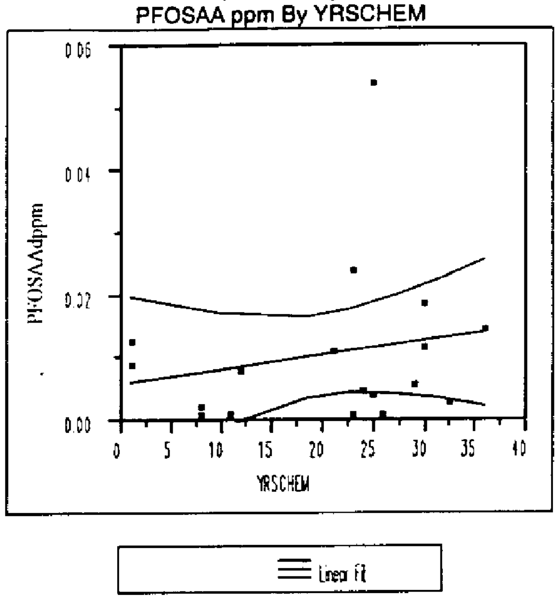
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	5.387336	5.38734	3.3199
Error	16	25.963931	1.62275	Prob>F
C Total	17	31.351267		0.0872

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3084084	0.655903	0.47	0.6446	-1.082036	1.698853
YRSCHEM	0.0523265	0.028718	1.82	0.0872	-0.008553	0.1132065

Random Sample
Supervisor/Mgmt
PFOSAA ppm By YRSCHEM



Linear Fit
PFOSAAdppm = 0.00595 + 0.00023 YRSCHEM

Summary of Fit

RSquare	0.036993
RSquare Adj	-0.0232
Root Mean Square Error	0.012927
Mean of Response	0.010586
Observations (or Sum Wgts)	8

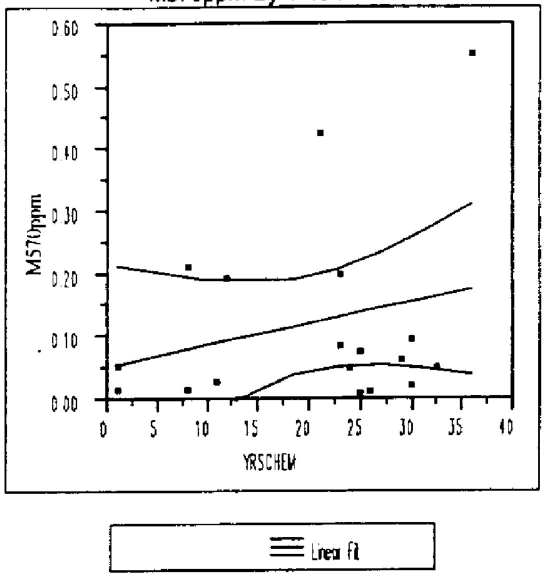
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00010271	0.000103	0.6146
Error	16	0.00267372	0.000167	Prob>F
C Total	17	0.00277643		0.4445

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0059463	0.006656	0.89	0.3849	-0.008164	0.0200562
YRSCHEM	0.0002285	0.000291	0.78	0.4445	-0.000389	0.0008463

Random Sample
Supervisor/Mgmt
M570ppm By YRSCHEM



Linear Fit

M570ppm = 0.05229 + 0.00341 YRSCHEM

Summary of Fit

RSquare	0.059465
RSquare Adj	0.000683
Root Mean Square Error	0.150515
Mean of Response	0.121594
Observations (or Sum Wgts)	18

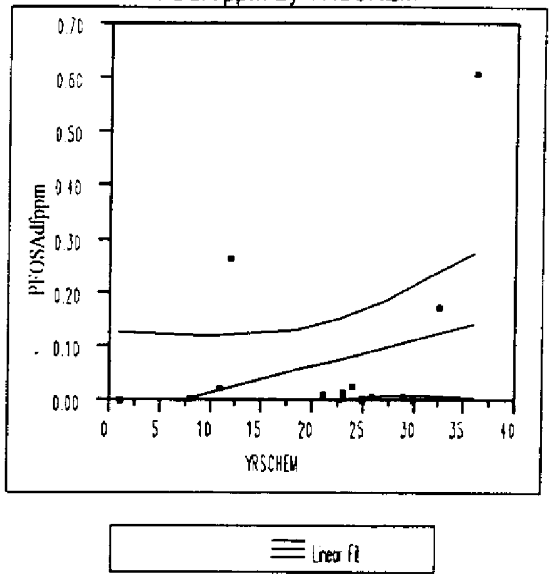
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.02291777	0.022918	1.0116
Error	16	0.36247508	0.022655	Prob>F
C Total	17	0.38539285		0.3295

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.052294	0.077498	0.67	0.5095	-0.111995	0.2165826
YRSCHEM	0.0034129	0.003393	1.01	0.3295	-0.00378	0.0106062

Random Sample
Supervisor/Mgmt
PFOSA ppm By YRSCHEM



Linear Fit

PFOSAdfppm = -0.0334 + 0.00483 YRSCHEM

Summary of Fit

RSquare	0.114214
RSquare Adj	0.058852
Root Mean Square Error	0.14906
Mean of Response	0.064622
Observations (or Sum Wgts)	18

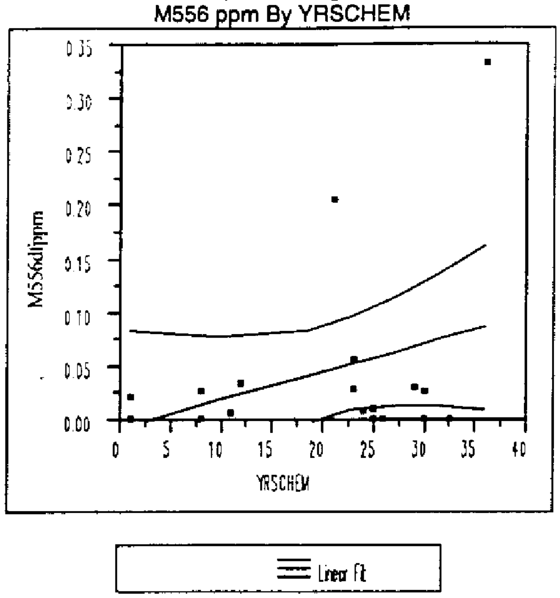
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.04583882	0.045839	2.0631
Error	16	0.35550303	0.022219	Prob>F
C Total	17	0.40134185		0.1702

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.033387	0.07675	-0.44	0.6694	-0.196088	0.129314
YRSCHEM	0.0048267	0.00336	1.44	0.1702	-0.002297	0.0119505

Random Sample
Supervisor/Mgmt
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = -0.007 + 0.00261 YRSCHEM

Summary of Fit

RSquare	0.105382
RSquare Adj	0.049469
Root Mean Square Error	0.084362
Mean of Response	0.046
Observations (or Sum Wgts)	18

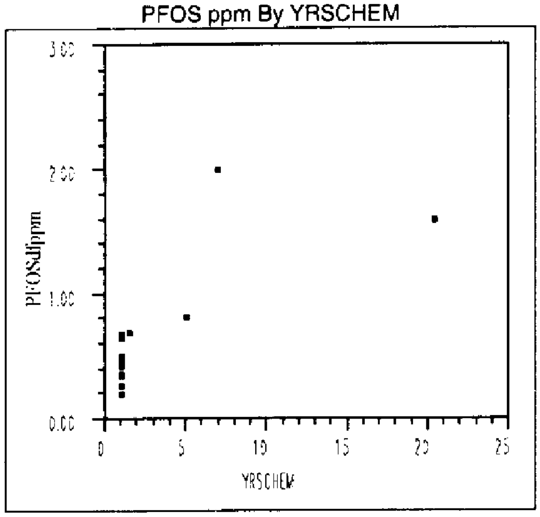
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01341369	0.013414	1.8847
Error	16	0.11387207	0.007117	Prob>F
C Total	17	0.12728576		0.1887

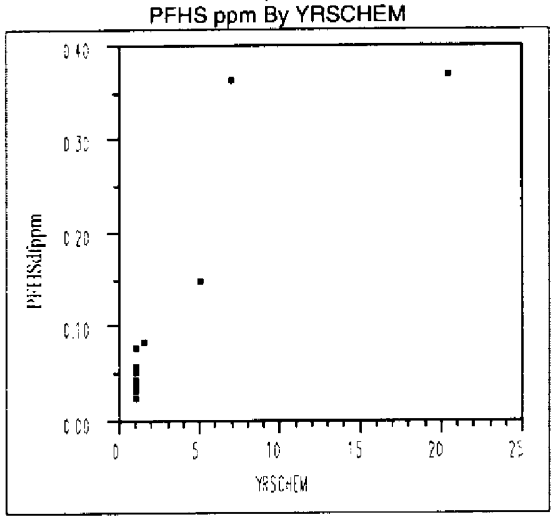
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.007018	0.043437	-0.16	0.8737	-0.099101	0.0850644
YRSCHEM	0.002611	0.001902	1.37	0.1887	-0.001421	0.0066428

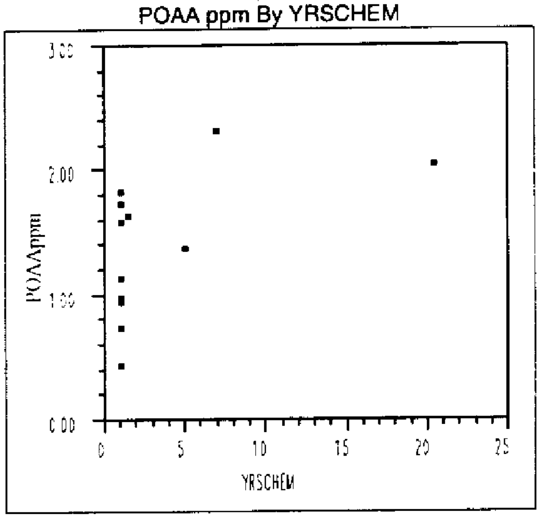
Random Sample
Mill Operators
PFOS ppm By YRSCHEM



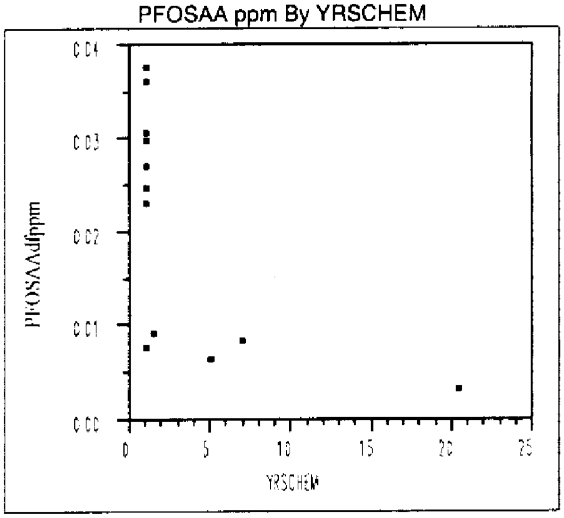
Random Sample
Mill Operators
PFHS ppm By YRSCHEM



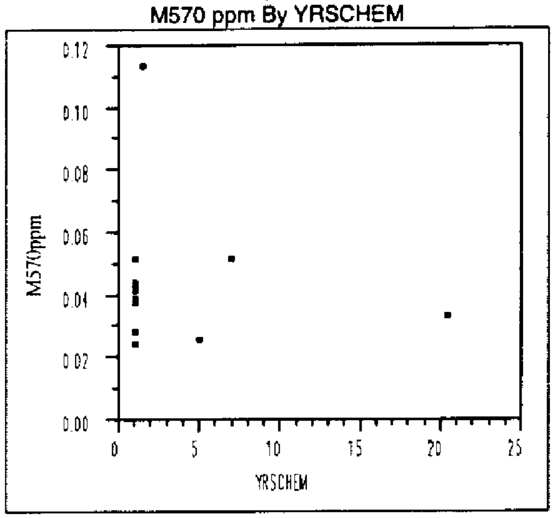
Random Sample
Mill Operators
POAA ppm By YRSCHEM



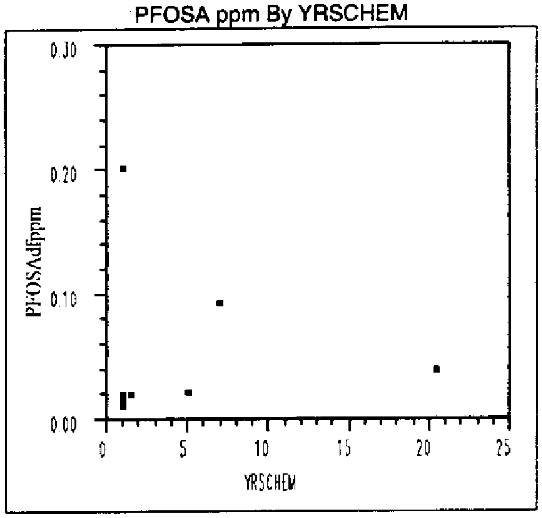
Random Sample
Mill Operators
PFOSAA ppm By YRSCHEM



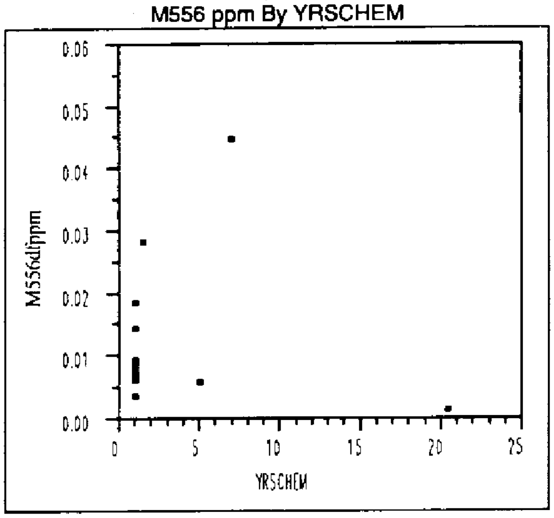
Random Sample
Mill Operators
M570 ppm By YRSCHEM



Random Sample
Mill Operators
PFOSA ppm By YRSCHEM



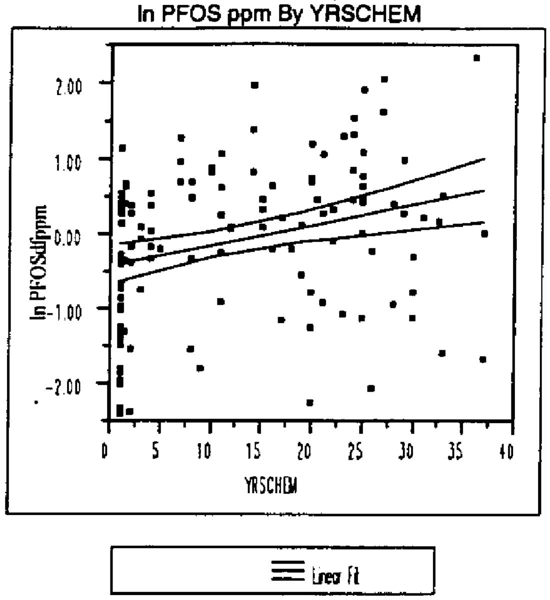
Random Sample
Mill Operators
M556 ppm By YRSCHEM



Appendix F

Scatterplots and regression equations for fluorochemicals (natural log transformation) by years worked in chemical (YRSCHEM) for all random sample (n = 126) and for two current job cateogries (chemical operators and engineer/lab)

Random Sample
ln PFOS ppm By YRSCHEM



Linear Fit

ln PFOSdfppm = -0.4008 + 0.02654 YRSCHEM

Summary of Fit

RSquare	0.082224
RSquare Adj	0.074823
Root Mean Square Error	0.987128
Mean of Response	-0.06052
Observations (or Sum Wgts)	126

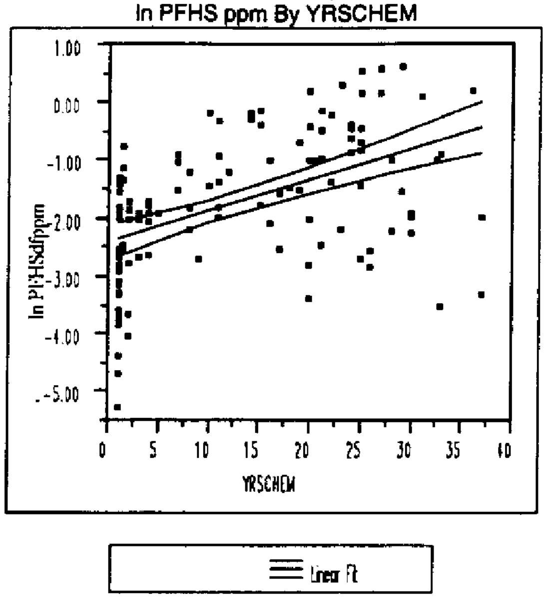
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	10.82508	10.8251	11.1092
Error	124	120.82819	0.9744	Prob>F
C Total	125	131.65326		0.0011

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.400807	0.134748	-2.97	0.0035	-0.667512	-0.134101
YRSCHEM	0.0265406	0.007963	3.33	0.0011	0.0107798	0.0423014

Random Sample
ln PFHS ppm By YRSCHEM



Linear Fit

ln PFHSdfppm = -2.4032 + 0.05366 YRSCHEM

Summary of Fit

RSquare	0.236894
RSquare Adj	0.230739
Root Mean Square Error	1.072243
Mean of Response	-1.7152
Observations (or Sum Wgts)	126

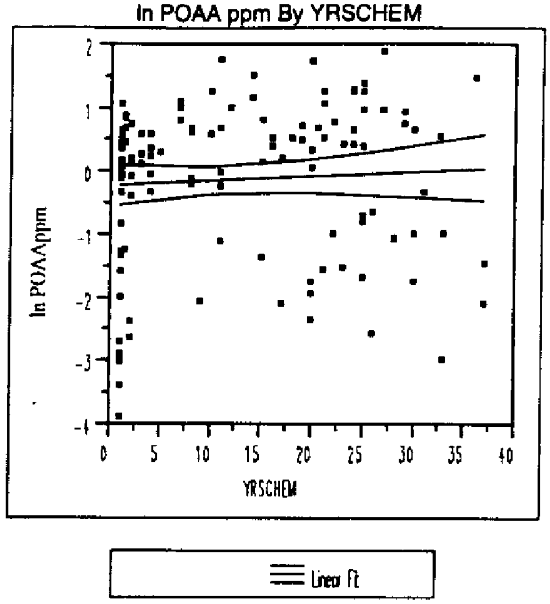
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	44.25642	44.2564	38.4937
Error	124	142.56346	1.1497	Prob>F
C Total	125	186.81988		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.403248	0.146366	-16.42	<.0001	-2.69295	-2.113546
YRSCHEM	0.053664	0.008649	6.20	<.0001	0.0365442	0.0707838

Random Sample
ln POAA ppm By YRSCHEM



Linear Fit
ln POAAppm = -0.2007 + 0.00738 YRSCHEM

Summary of Fit

RSquare	0.004252
RSquare Adj	-0.003778
Root Mean Square Error	1.256877
Mean of Response	-0.10609
Observations (or Sum Wgts)	126

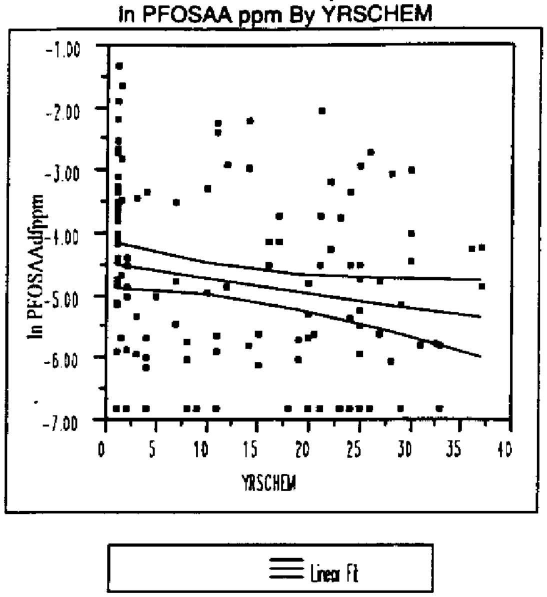
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.83656	0.83656	0.5296
Error	124	195.88769	1.57974	Prob>F
C Total	125	196.72425		0.4682

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.200686	0.17157	-1.17	0.2444	-0.540273	0.1389006
YRSCHEM	0.0073781	0.010139	0.73	0.4682	-0.01269	0.0274458

Random Sample
ln PFOSAA ppm By YRSCHEM



Linear Fit
ln PFOSAAdfppm = -4.478 – 0.02366 YRSCHEM

Summary of Fit

RSquare	0.03232
RSquare Adj	0.02451
Root Mean Square Error	1.44119
Mean of Response	-4.781
Observations (or Sum Wgts)	126

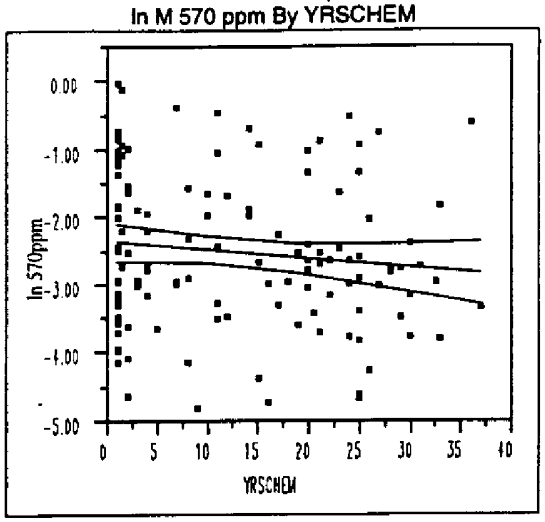
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	8.60226	8.60226	4.1416
Error	124	257.55240	2.07704	Prob>F
C Total	125	266.15466		0.0440

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.477958	0.19673	-22.76	<.0001	-4.867344	-4.088572
YRSCHEM	-0.023659	0.011626	-2.04	0.0440	-0.04667	-0.000649

Random Sample
ln M 570 ppm By YRSCHEM



Linear Fit

Linear Fit

ln 570ppm = -2.353 – 0.0126 YRSCHEM

Summary of Fit

RSquare	0.015641
RSquare Adj	0.007702
Root Mean Square Error	1.112421
Mean of Response	-2.51453
Observations (or Sum Wgts)	126

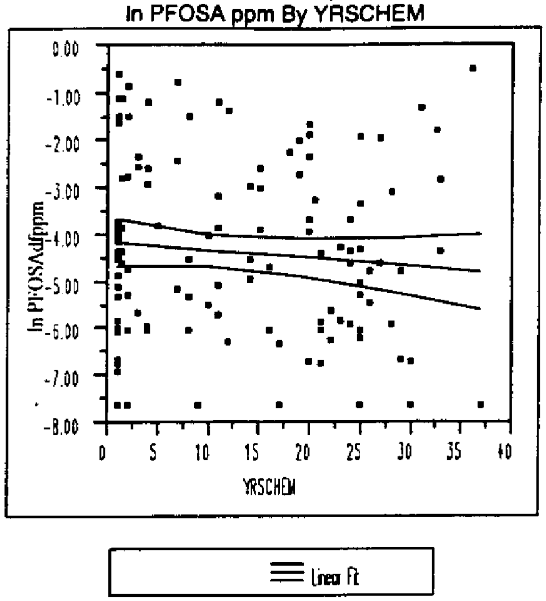
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.43817	2.43817	1.9703
Error	124	153.44766	1.23748	Prob>F
C Total	125	155.88583		0.1629

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-2.353036	0.151851	-15.50	<.0001
YRSCHEM	-0.012596	0.008974	-1.40	0.1629

Random Sample
ln PFOSA ppm By YRSCHEM



Linear Fit

ln PFOSAdfppm = -4.1363 - 0.01701 YRSCHEM

Summary of Fit

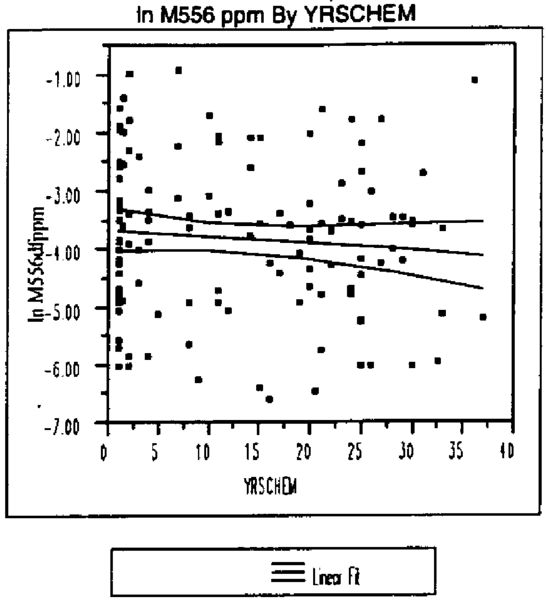
RSquare	0.009846
RSquare Adj	0.001861
Root Mean Square Error	1.899215
Mean of Response	-4.35445
Observations (or Sum Wgts)	126

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.44768	4.44768	1.2331
Error	124	447.26998	3.60702	Prob>F
C Total	125	451.71766		0.2690

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Lower 95%	Upper 95%
Intercept	-4.13633	0.259252	-15.95	-4.649466	-3.623194
YRSCHEM	-0.017012	0.01532	-1.11	-0.047336	0.0133113



Linear Fit

ln M556dfppm = -3.6365 – 0.01244 YRSCHEM

Summary of Fit

RSquare	0.010236
RSquare Adj	0.002254
Root Mean Square Error	1.362297
Mean of Response	-3.79603
Observations (or Sum Wgts)	126

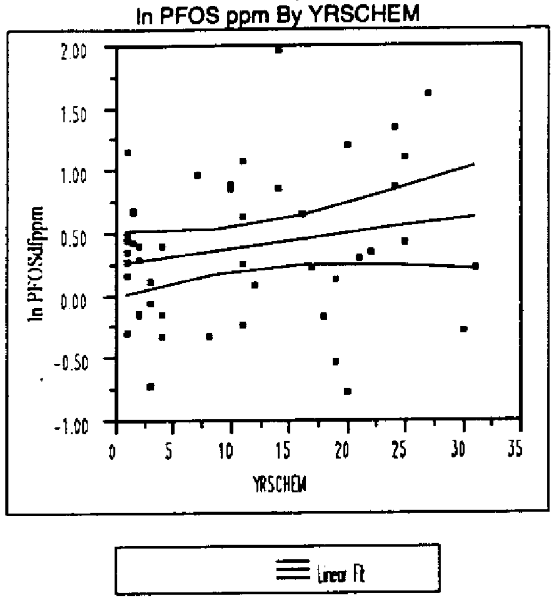
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.38002	2.38002	1.2824
Error	124	230.12586	1.85585	Prob>F
C Total	125	232.50588		0.2596

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.636469	0.18596	-19.56	<.0001	-4.004539	-3.268399
YRSCHEM	-0.012445	0.010989	-1.13	0.2596	-0.034196	0.0093062

Random Sample
Chemical Operators
ln PFOS ppm By YRSCHEM



Linear Fit
ln PFOSdfppm = 0.25621 + 0.0124 YRSCHEM

Summary of Fit

RSquare	0.038311
RSquare Adj	0.01694
Root Mean Square Error	0.589163
Mean of Response	0.392725
Observations (or Sum Wgts)	47

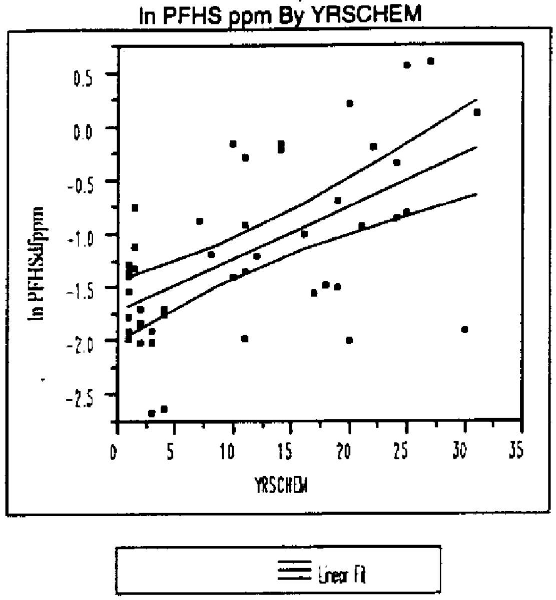
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.622261	0.622261	1.7927
Error	45	15.620109	0.347114	Prob>F
C Total	46	16.242370		0.1873

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.2562063	0.133348	1.92	0.0610	-0.01237	0.524783
YRSCHEM	0.0123988	0.00926	1.34	0.1873	-0.006253	0.0310501

Random Sample
Chemical Operators
ln PFHS ppm By YRSCHEM



Linear Fit

ln PFHSdfppm = -1.7176 + 0.0491 YRSCHEM

Summary of Fit

RSquare	0.345573
RSquare Adj	0.331035
Root Mean Square Error	0.640812
Mean of Response	-1.17704
Observations (or Sum Wgts)	47

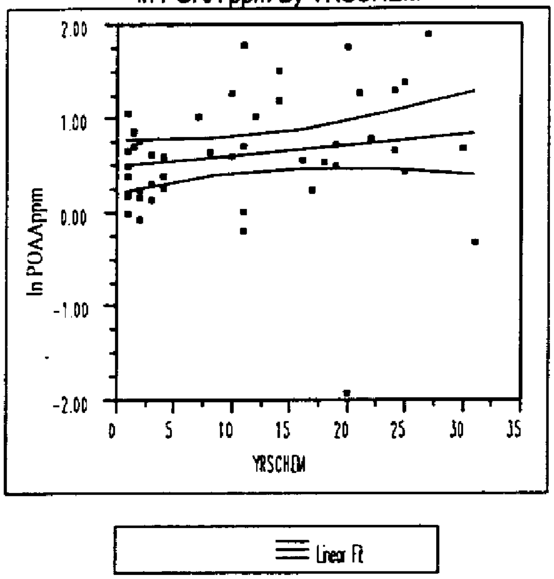
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	9.758008	9.75801	23.7629
Error	45	18.478805	0.41064	Prob>F
C Total	46	28.236813		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.717649	0.145038	-11.84	<.0001	-2.00977	-1.425527
YRSCHEM	0.0490992	0.010072	4.87	<.0001	0.0288128	0.0693855

Random Sample
Chemical Operators
ln POAA ppm By YRSCHEM



Linear Fit
ln POAAppm = 0.51048 + 0.01132 YRSCHEM

Summary of Fit

RSquare	0.027722
RSquare Adj	0.006116
Root Mean Square Error	0.635686
Mean of Response	0.635094
Observations (or Sum Wgts)	47

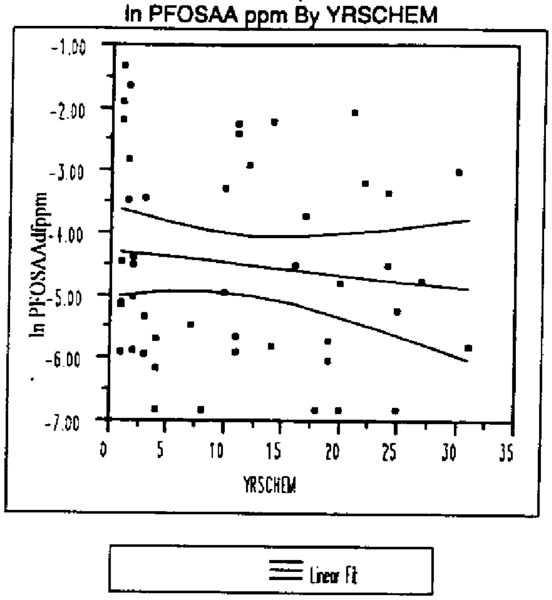
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.518477	0.518477	1.2831
Error	45	18.184368	0.404097	Prob>F
C Total	46	18.702845		0.2633

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.5104788	0.143878	3.55	0.0009	0.2206941	0.8002634
YRSCHEM	0.0113177	0.009992	1.13	0.2633	-0.008806	0.0314418

Random Sample
Chemical Operators
ln PFOSAA ppm By YRSCHEM



Linear Fit

ln PFOSAAdfppm = -4.2679 – 0.01959 YRSCHEM

Summary of Fit

RSquare	0.013261
RSquare Adj	-0.00867
Root Mean Square Error	1.603004
Mean of Response	-4.4836
Observations (or Sum Wgts)	47

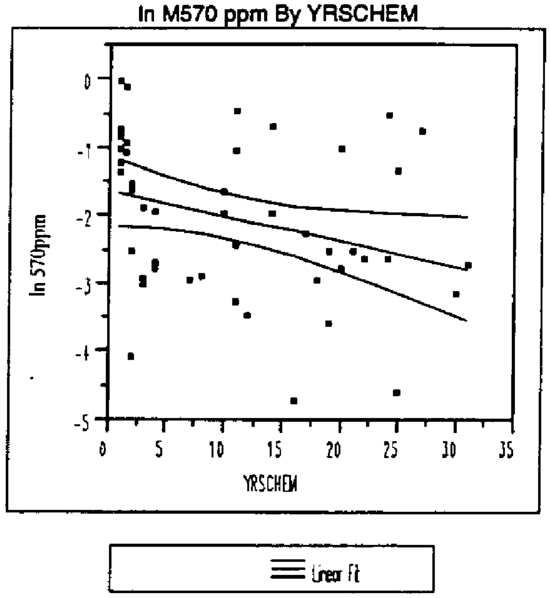
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.55397	1.55397	0.6047
Error	45	115.63304	2.56962	Prob>F
C Total	46	117.18701		0.4408

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.267867	0.362816	-11.76	<.0001	-4.998614	-3.537119
YRSCHEM	-0.019594	0.025196	-0.78	0.4408	-0.07034	0.0311532

Random Sample
Chemical Operators
ln M570 ppm By YRSCHEM



Linear Fit
ln 570ppm = -1.6206 – 0.03729 YRSCHEM

Summary of Fit

RSquare	0.09218
RSquare Adj	0.072006
Root Mean Square Error	1.109871
Mean of Response	-2.03122
Observations (or Sum Wgts)	47

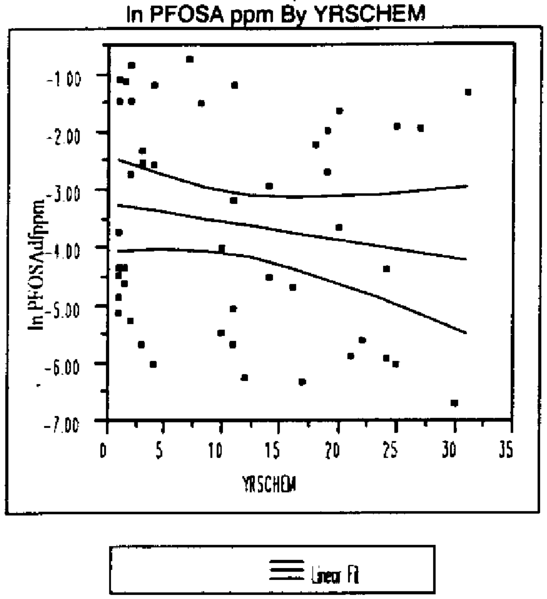
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	5.628506	5.62851	4.5693
Error	45	55.431655	1.23181	Prob>F
C Total	46	61.060161		0.0380

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.620635	0.251203	-6.45	<.0001	-2.126582	-1.114688
YRSCHEM	-0.03729	0.017445	-2.14	0.0380	-0.072425	-0.002154

Random Sample
Chemical Operators
ln PFOSA ppm By YRSCHEM



Linear Fit
ln PFOSAdfppm = -3.2174 – 0.03217 YRSCHEM

Summary of Fit

RSquare	0.026974
RSquare Adj	0.005351
Root Mean Square Error	1.832598
Mean of Response	-3.57167
Observations (or Sum Wgts)	47

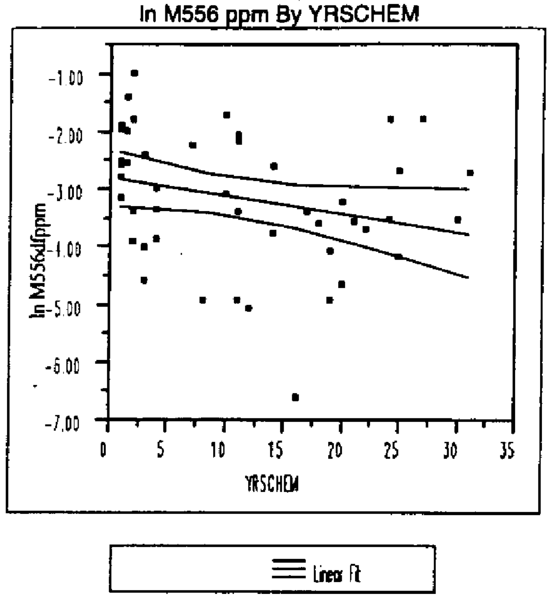
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.18951	4.18951	1.2475
Error	45	151.12876	3.35842	Prob>F
C Total	46	155.31826		0.2700

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.217438	0.414782	-7.76	<.0001	-4.052848	-2.382028
YRSCHEM	-0.032172	0.028805	-1.12	0.2700	-0.090187	0.0258433

Random Sample
Chemical Operators
ln M556 ppm By YRSCHEM



Linear Fit
ln M556dfppm = -2.7767 – 0.03141 YRSCHEM

Summary of Fit

RSquare	0.065942
RSquare Adj	0.045185
Root Mean Square Error	1.121235
Mean of Response	-3.12253
Observations (or Sum Wgts)	47

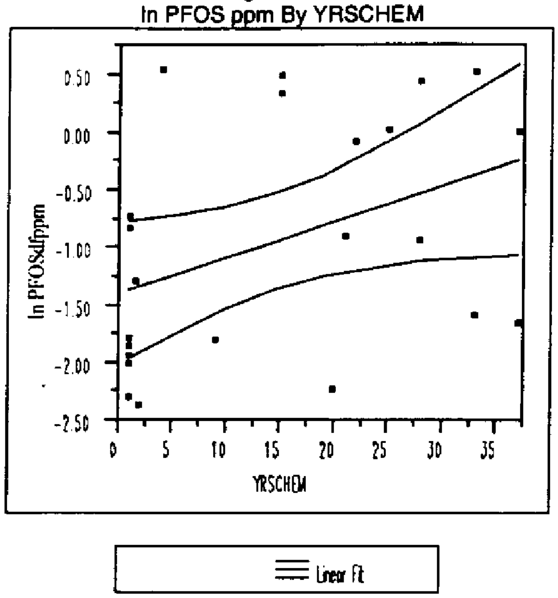
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	3.993849	3.99385	3.1769
Error	45	56.572602	1.25717	Prob>F
C Total	46	60.566451		0.0814

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.776667	0.253775	-10.94	<.0001	-3.287794	-2.265539
YRSCHEM	-0.031412	0.017623	-1.78	0.0814	-0.066907	0.0040837

Random Sample
Engineer/Lab
ln PFOS ppm By YRSCHEM



Linear Fit
ln PFOSdfppm = -1.4007 + 0.03146 YRSCHEM
Summary of Fit

RSquare	0.170302
RSquare Adj	0.130793
Root Mean Square Error	0.963504
Mean of Response	-0.93898
Observations (or Sum Wgts)	23

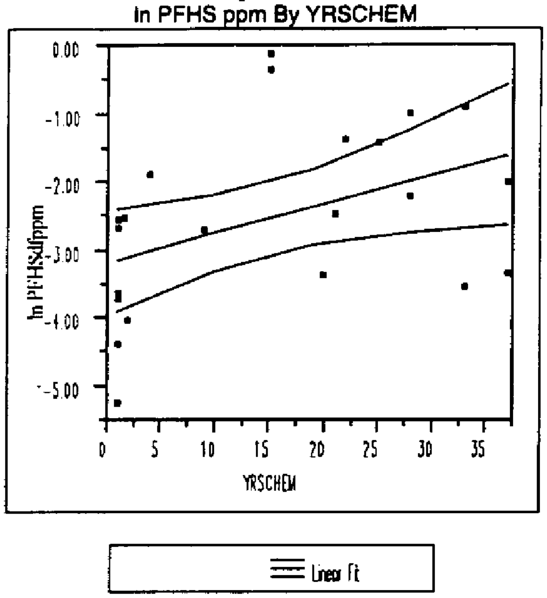
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.001539	4.00154	4.3104
Error	21	19.495151	0.92834	Prob>F
C Total	22	23.496691		0.0503

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.40069	0.299699	-4.67	0.0001	-2.023942	-0.777437
YRSCHEM	0.0314649	0.015155	2.08	0.0503	-0.000052	0.0629819

Random Sample
Engineer/Lab
ln PFHS ppm By YRSCHEM



Linear Fit

ln PFHSdfppm = -3.1745 + 0.04275 YRSCHEM

Summary of Fit

RSquare	0.192846
RSquare Adj	0.15441
Root Mean Square Error	1.213305
Mean of Response	-2.54721
Observations (or Sum Wgts)	23

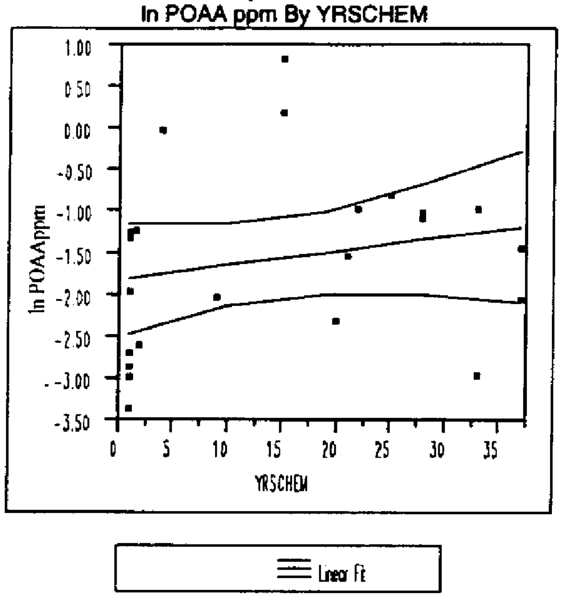
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	7.386077	7.38608	5.0173
Error	21	30.914308	1.47211	Prob>F
C Total	22	38.300386		0.0360

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.174495	0.377399	-8.41	<.0001	-3.959334	-2.389657
YRSCHEM	0.0427483	0.019085	2.24	0.0360	0.0030601	0.0824366

Random Sample
Engineer/Lab
ln POAA ppm By YRSCHEM



Linear Fit

ln POAAppm = -1.8235 + 0.01742 YRSCHEM

Summary of Fit

RSquare	0.047702
RSquare Adj	0.002355
Root Mean Square Error	1.079651
Mean of Response	-1.56794
Observations (or Sum Wgts)	23

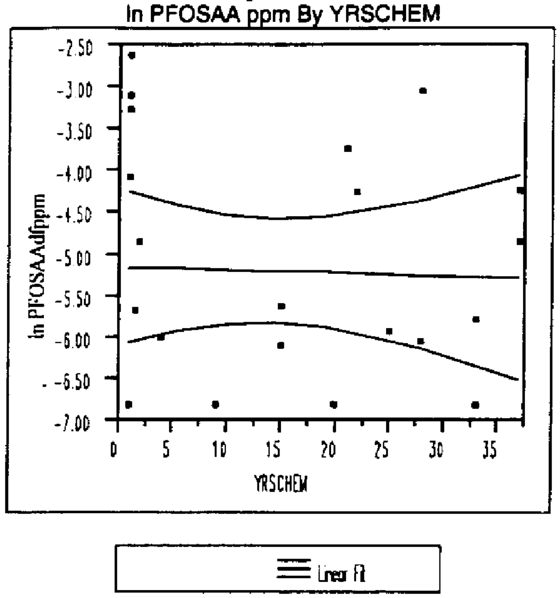
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.226171	1.22617	1.0519
Error	21	24.478567	1.16565	Prob>F
C Total	22	25.704738		0.3167

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.823526	0.335826	-5.43	<.0001	-2.521909	-1.125143
YRSCHEM	0.0174176	0.016982	1.03	0.3167	-0.017899	0.0527339

Random Sample
Engineer/Lab
ln PFOSAA ppm By YRSCHEM



Linear Fit
ln PFOSAAdfppm = -5.15 – 0.00367 YRSCHEM

Summary of Fit

RSquare	0.001234
RSquare Adj	-0.04633
Root Mean Square Error	1.44825
Mean of Response	-5.2038
Observations (or Sum Wgts)	23

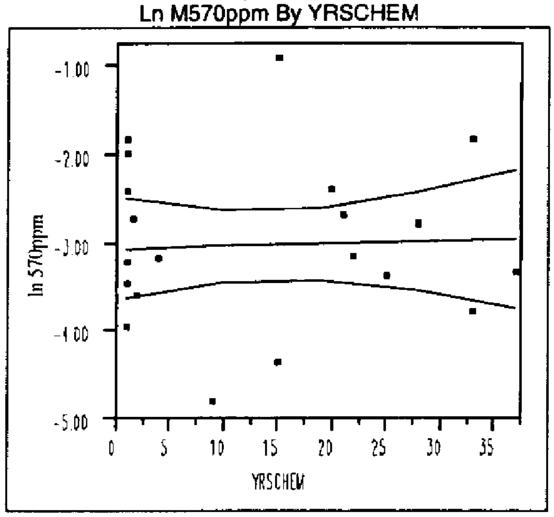
Analysis of Variance

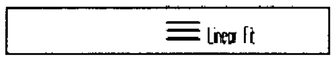
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.054411	0.05441	0.0259
Error	21	44.045995	2.09743	Prob>F
C Total	22	44.100406		0.8736

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.149964	0.450479	-11.43	<.0001	-6.086779	-4.213149
YRSCHEM	-0.003669	0.02278	-0.16	0.8736	-0.051043	0.0437044

Random Sample
Engineer/Lab
Ln M570ppm By YRSCHEM





Linear Fit

ln 570ppm = -3.0598 + 0.00297 YRSCHEM

Summary of Fit

RSquare	0.002026
RSquare Adj	-0.0455
Root Mean Square Error	0.915637
Mean of Response	-3.01612
Observations (or Sum Wgts)	23

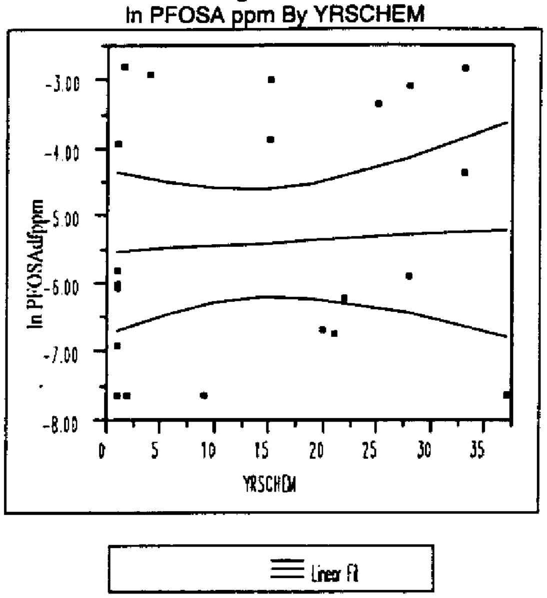
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.035747	0.035747	0.0426
Error	21	17.606219	0.838391	Prob>F
C Total	22	17.641966		0.8384

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.059762	0.284809	-10.74	<.0001	-3.652051	-2.467473
YRSCHEM	0.0029739	0.014402	0.21	0.8384	-0.026977	0.0329252

Random Sample
Engineer/Lab
ln PFOSA ppm By YRSCHEM



Linear Fit

ln PFOSAdfppm = -5.5202 + 0.00865 YRSCHEM

Summary of Fit

RSquare	0.004124
RSquare Adj	-0.0433
Root Mean Square Error	1.864648
Mean of Response	-5.39325
Observations (or Sum Wgts)	23

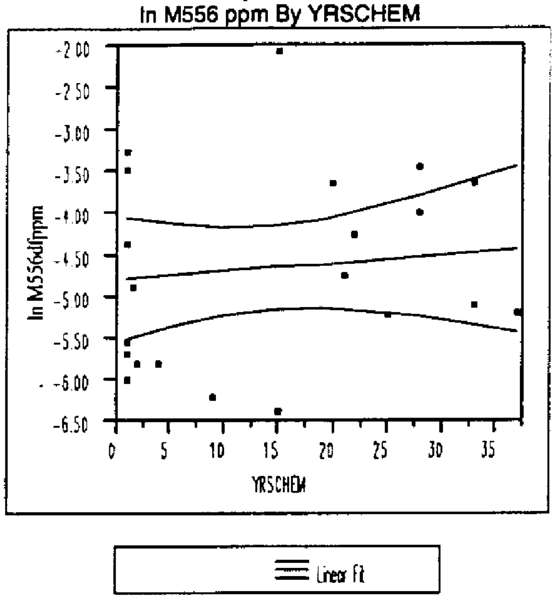
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.302390	0.30239	0.0870
Error	21	73.015154	3.47691	Prob>F
C Total	22	73.317544		0.7710

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.520173	0.58	-9.52	<.0001	-6.726339	-4.314007
YRSCHEM	0.0086496	0.02933	0.29	0.7710	-0.052345	0.0696438

Random Sample
Engineer/Lab
ln M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -4.7931 + 0.00973 YRSCHEM

Summary of Fit

RSquare	0.013025
RSquare Adj	-0.03397
Root Mean Square Error	1.174741
Mean of Response	-4.65037
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.382462	0.38246	0.2771
Error	21	28.980362	1.38002	Prob>F
C Total	22	29.362824		0.6041

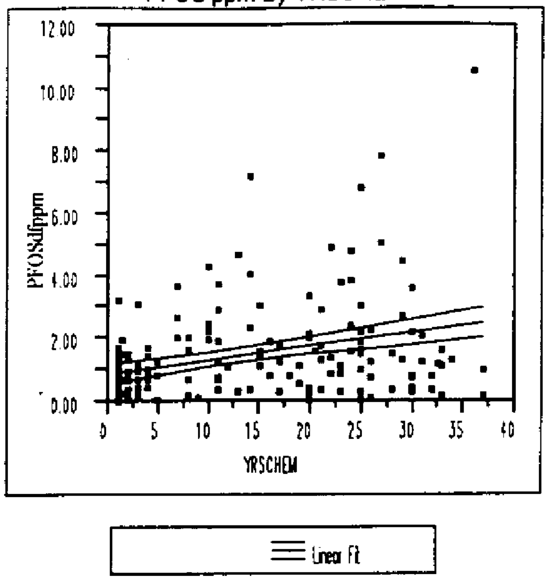
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.793115	0.365404	-13.12	<.0001	-5.553008	-4.033222
YRSCHEM	0.0097276	0.018478	0.53	0.6041	-0.028699	0.0481544

Appendix G

Scatterplots and regression equations for fluorochemicals b y years worked in chemical(YRSCHEM) for all chemical participants (n = 187) for current job categories (cell operators, chemical operators, engineer/lab, maintenance, mill operators and supervisor/mgmt)

All Participants
PFOS ppm By YRSCHEM



Linear Fit
PFOSdfppm = 0.87788 + 0.04433 YRSCHEM

Summary of Fit

RSquare	0.109673
RSquare Adj	0.10486
Root Mean Square Error	1.424349
Mean of Response	1.424443
Observations (or Sum Wgts)	187

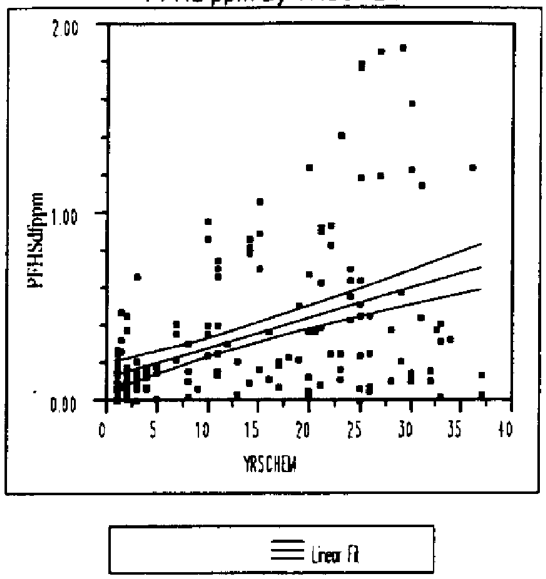
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	46.23325	46.2333	22.7888
Error	185	375.32259	2.0288	Prob>F
C Total	186	421.55584		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.8778797	0.154783	5.67	<.0001	0.5725098	1.1832495
YRSCHEM	0.0443319	0.009287	4.77	<.0001	0.0260105	0.0626534

All Participants
PFHS ppm By YRSCHEM



Linear Fit

PFHSdfppm = 0.12463 + 0.01594 YRSCHEM

Summary of Fit

RSquare	0.210847
RSquare Adj	0.206581
Root Mean Square Error	0.347846
Mean of Response	0.321211
Observations (or Sum Wgts)	187

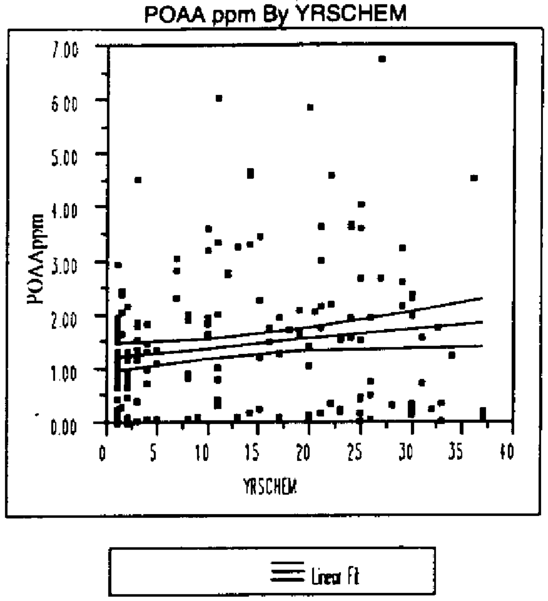
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	5.980711	5.98071	49.4286
Error	185	22.384463	0.12100	Prob>F
C Total	186	28.365174		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1246314	0.0378	3.30	0.0012	0.0500558	0.1992071
YRSCHEM	0.0159447	0.002268	7.03	<.0001	0.0114703	0.020419

All Participants
POAA ppm By YRSCHEM



Linear Fit

POAAppm = 1.20809 + 0.01788 YRSCHEM

Summary of Fit

RSquare	0.024711
RSquare Adj	0.019439
Root Mean Square Error	1.266529
Mean of Response	1.42851
Observations (or Sum Wgts)	187

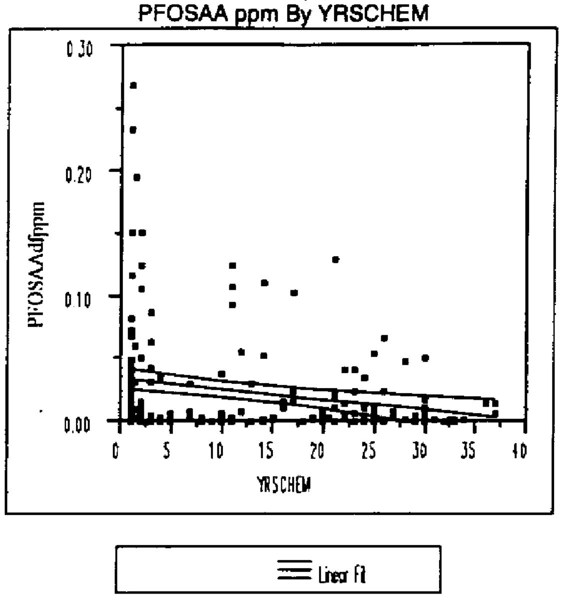
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	7.51900	7.51900	4.6874
Error	185	296.75766	1.60410	Prob>F
C Total	186	304.27666		0.0317

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.2080941	0.137633	8.78	<.0001	0.9365598	1.4796284
YRSCHEM	0.017878	0.008258	2.17	0.0317	0.0015867	0.0341694

All Participants
PFOSAA ppm By YRSCHEM



Linear Fit

PFOSAAdfppm = 0.03463 – 0.00084 YRSCHEM

Summary of Fit

RSquare	0.052504
RSquare Adj	0.047383
Root Mean Square Error	0.04017
Mean of Response	0.024293
Observations (or Sum Wgts)	187

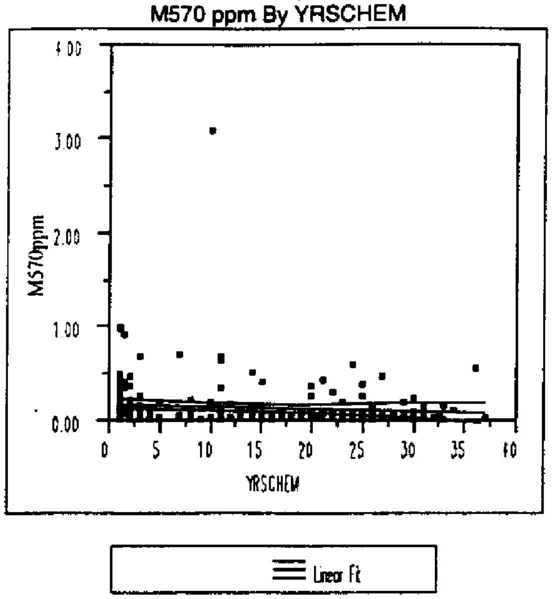
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01654217	0.016542	10.2516
Error	185	0.29852064	0.001614	Prob>F
C Total	186	0.31506281		0.0016

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0346317	0.004365	7.93	<.0001	0.0260196	0.0432438
YRSCHEM	-0.000839	0.000262	-3.20	0.0016	-0.001355	-0.000322

All Participants
M570 ppm By YRSCHEM



Linear Fit

M570ppm = 0.1882 – 0.00247 YRSCHEM

Summary of Fit

RSquare	0.009497
RSquare Adj	0.004143
Root Mean Square Error	0.283957
Mean of Response	0.157804
Observations (or Sum Wgts)	187

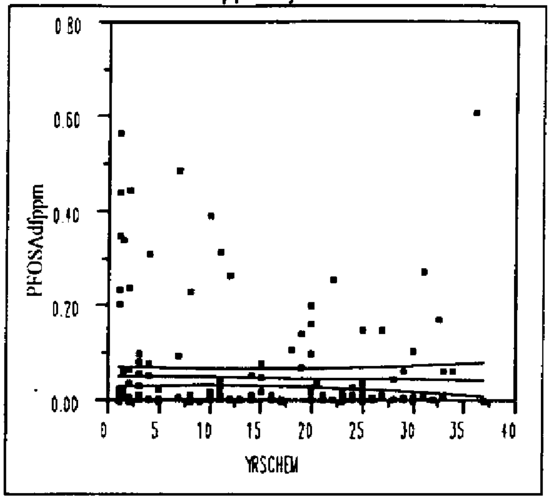
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.143025	0.143025	1.7738
Error	185	14.916841	0.080632	Prob>F
C Total	186	15.059866		0.1845

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.188204	0.030857	6.10	<.0001	0.1273257	0.2490822
YRSCHEM	-0.002466	0.001851	-1.33	0.1845	-0.006118	0.0011868

All Participants
PFOSA ppm By YRSCHEM



Linear Fit

Linear Fit

PFOSAdfppm = 0.05391 – 0.00022 YRSCHEM

Summary of Fit

RSquare	0.000516
RSquare Adj	-0.00489
Root Mean Square Error	0.107249
Mean of Response	0.051246
Observations (or Sum Wgts)	187

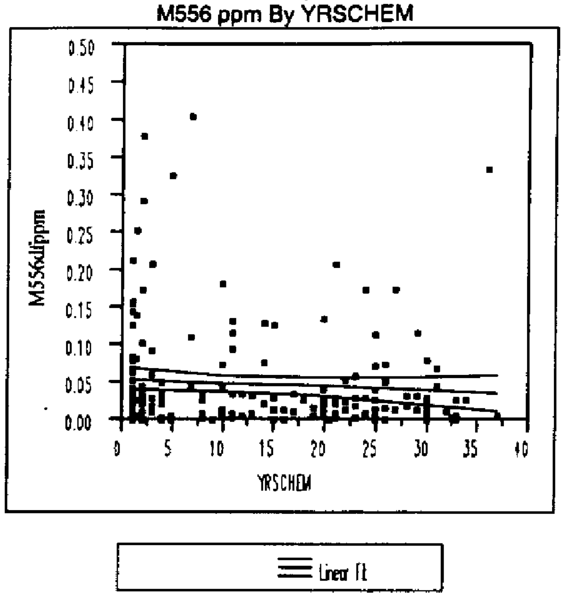
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0010985	0.001098	0.0955
Error	185	2.1279346	0.011502	Prob>F
C Total	186	2.1290331		0.7576

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0539099	0.011655	4.63	<.0001	0.0309165	0.0769033
YRSCHEM	-0.000216	0.000699	-0.31	0.7576	-0.001596	0.0011635

All Participants
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = 0.05481 – 0.00053 YRSCHEM

Summary of Fit

RSquare	0.007159
RSquare Adj	0.001763
Root Mean Square Error	0.07024
Mean of Response	0.048273
Observations (or Sum Wgts)	186

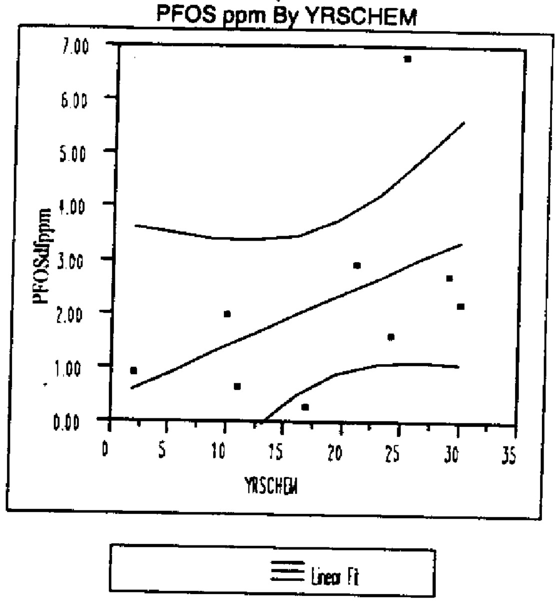
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00654604	0.006546	1.3268
Error	184	0.90780250	0.004934	Prob>F
C Total	185	0.91434853		0.2509

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0548148	0.007667	7.15	<.0001	0.039688	0.0699416
YRSCHEM	-0.000528	0.000459	-1.15	0.2509	-0.001434	0.0003767

All Participants
Cell Operators
PFOS ppm By YRSCHEM



Linear Fit
PFOSdfppm = 0.41242 + 0.09869 YRSCHEM

Summary of Fit

RSquare	0.23418
RSquare Adj	0.124777
Root Mean Square Error	1.814425
Mean of Response	2.265556
Observations (or Sum Wgts)	9

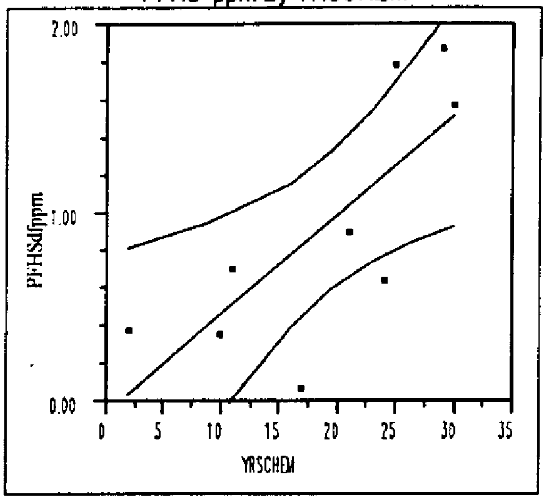
Analysis of Variance

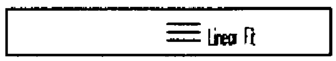
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	7.046913	7.04691	2.1405
Error	7	23.044960	3.29214	Prob>F
C Total	8	30.091872		0.1869

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.4124178	1.403612	0.29	0.7774	-2.906623	3.7314586
YRSCHEM	0.0986878	0.067453	1.46	0.1869	-0.060815	0.2581907

All Participants
Cell Operators
PFHS ppm By YRSCHEM





Linear Fit

PFHSdfppm = -0.0673 + 0.05293 YRSCHEM

Summary of Fit

RSquare	0.573083
RSquare Adj	0.512095
Root Mean Square Error	0.464481
Mean of Response	0.926611
Observations (or Sum Wgts)	9

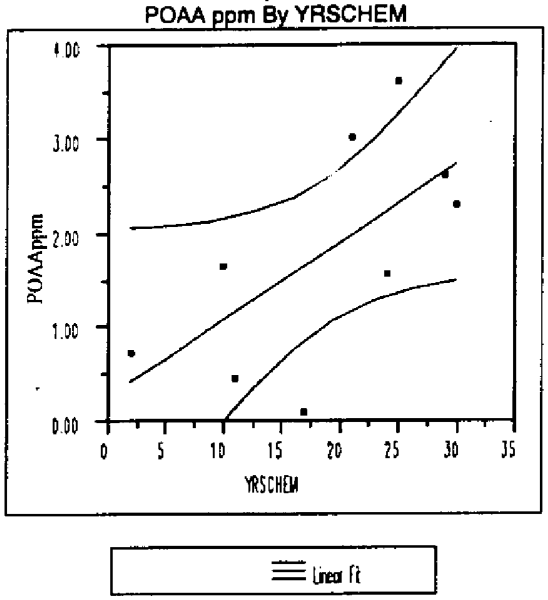
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.0272533	2.02725	9.3966
Error	7	1.5101985	0.21574	Prob>F
C Total	8	3.5374519		0.0182

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.067334	0.359316	-0.19	0.8567	-0.916987	0.7823194
YRSCHEM	0.052932	0.017268	3.07	0.0182	0.0121003	0.0937637

All Participants
Cell Operators
POAA ppm By YRSCHEM



Linear Fit

POAAppm = 0.25794 + 0.08268 YRSCHEM

Summary of Fit

RSquare	0.423489
RSquare Adj	0.34113
Root Mean Square Error	0.980819
Mean of Response	1.810556
Observations (or Sum Wgts)	9

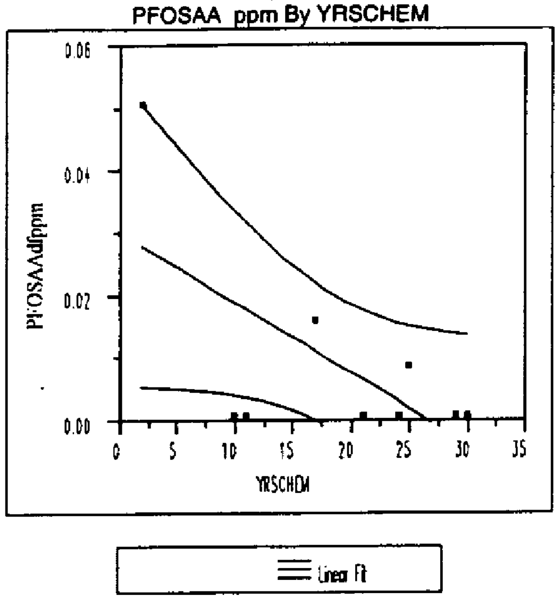
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.946633	4.94663	5.1420
Error	7	6.734042	0.96201	Prob>F
C Total	8	11.680674		0.0577

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.257943	0.758747	0.34	0.7439
YRSCHEM	0.0826835	0.036463	2.27	0.0577

All Participants
Cell Operators
PFOSAA ppm By YRSCHEM



Linear Fit

PFOSAAdfppm = 0.03031 – 0.00112 YRSCHEM

Summary of Fit

RSquare	0.418421
RSquare Adj	0.335339
Root Mean Square Error	0.013461
Mean of Response	0.009223
Observations (or Sum Wgts)	9

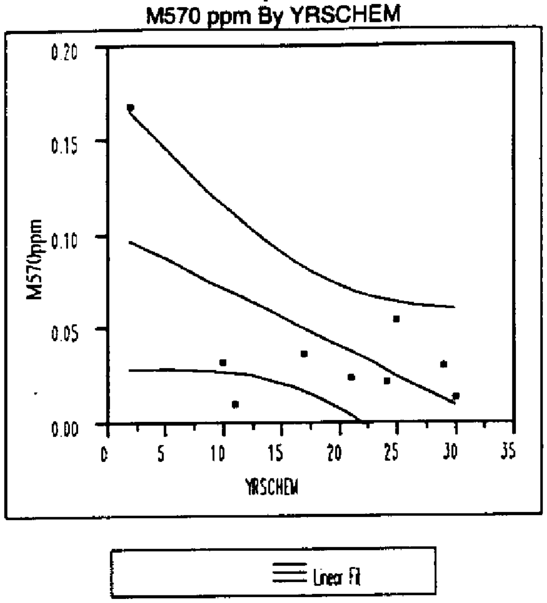
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00091259	0.000913	5.0362
Error	7	0.00126844	0.000181	Prob>F
C Total	8	0.00218103		0.0597

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0303118	0.010413	2.91	0.0226
YRSCHEM	-0.001123	0.0005	-2.24	0.0597

All Participants
Cell Operators
M570 ppm By YRSCHEM



Linear Fit

M570ppm = 0.10376 – 0.00314 YRSCHEM

Summary of Fit

RSquare	0.380736
RSquare Adj	0.292269
Root Mean Square Error	0.040686
Mean of Response	0.044833
Observations (or Sum Wgts)	9

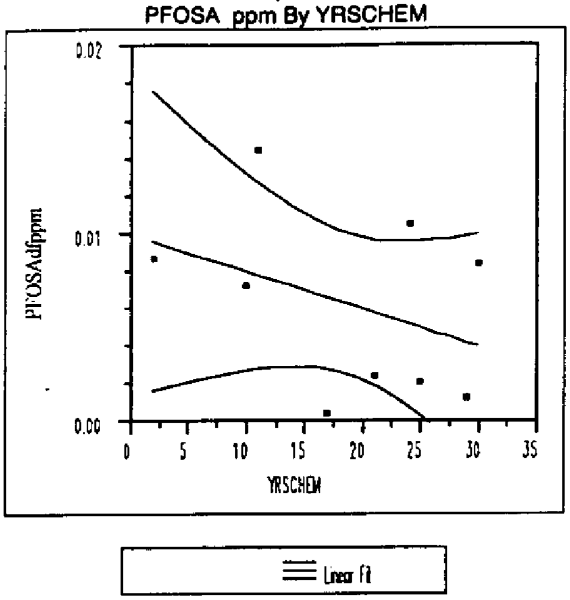
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00712436	0.007124	4.3037
Error	7	0.01158772	0.001655	Prob>F
C Total	8	0.01871208		0.0767

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1037558	0.031474	3.30	0.0132	0.02933	0.1781816
YRSCHEM	-0.003138	0.001513	-2.07	0.0767	-0.006715	0.0004388

All Participants
Cell Operators
PFOSA ppm By YRSCHEM



Linear Fit

PFOSAdfppm = 0.01002 – 0.0002 YRSCHEM

Summary of Fit

RSquare	0.152809
RSquare Adj	0.031782
Root Mean Square Error	0.004794
Mean of Response	0.006259
Observations (or Sum Wgts)	9

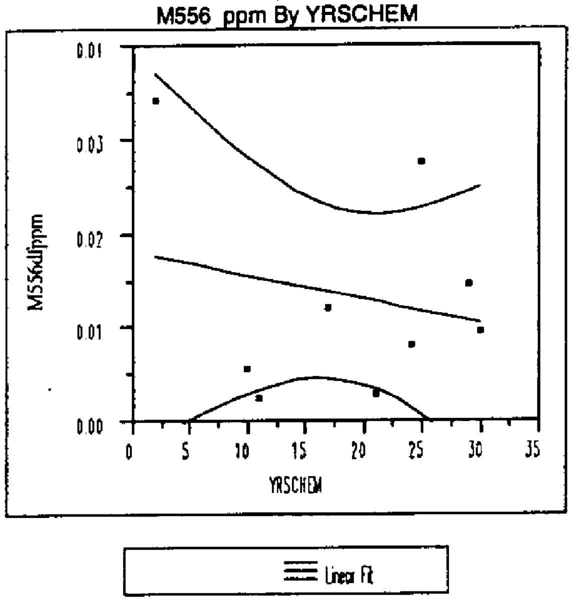
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00002902	0.000029	1.2626
Error	7	0.00016088	0.000023	Prob>F
C Total	8	0.00018990		0.2982

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0100194	0.003709	2.70	0.0306	0.0012498	0.018789
YRSCHEM	-0.0002	0.000178	-1.12	0.2982	-0.000622	0.0002212

All Participants
Cell Operators
M556 ppm By YRSCHEM



Linear Fit
M556dfppm = 0.01826 – 0.00025 YRSCHEM

Summary of Fit

RSquare	0.04781
RSquare Adj	-0.08822
Root Mean Square Error	0.011547
Mean of Response	0.013478
Observations (or Sum Wgts)	9

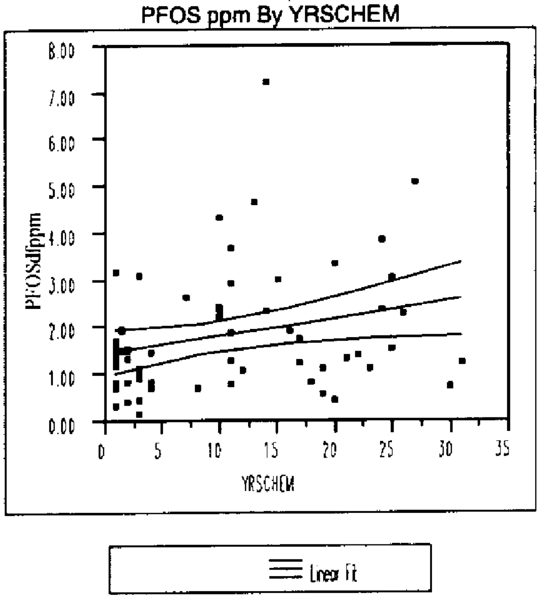
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00004686	0.000047	0.3515
Error	7	0.00093337	0.000133	Prob>F
C Total	8	0.00098024		0.5719

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0182567	0.008933	2.04	0.0803
YRSCHEM	-0.000254	0.000429	-0.59	0.5719

All Participants
Chemical Operators
PFOS ppm By YRSCHEM



Linear Fit
PFOSdfppm = 1.45105 + 0.03765 YRSCHEM
Summary of Fit

RSquare	0.070586
RSquare Adj	0.055596
Root Mean Square Error	1.25103
Mean of Response	1.839062
Observations (or Sum Wgts)	64

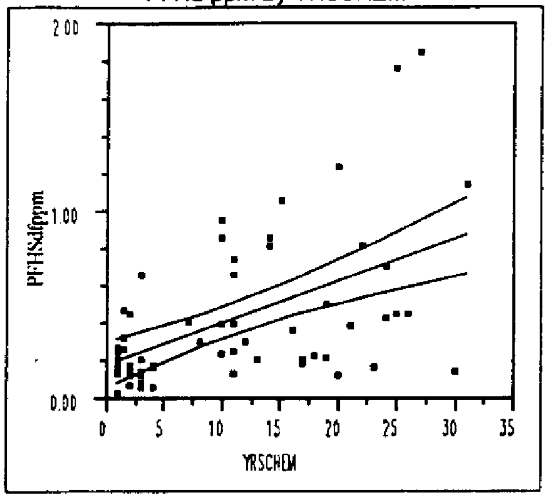
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	7.36950	7.36950	4.7087
Error	62	97.03475	1.56508	Prob>F
C Total	63	104.40425		0.0339

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.4510518	0.237545	6.11	<.0001	0.9762066	1.925897
YRSCHEM	0.0376538	0.017352	2.17	0.0339	0.002967	0.0723406

All Participants
Chemical Operators
PFHS ppm By YRSCHEM



Linear Fit

PFHSdfppm = 0.17914 + 0.02247 YRSCHEM

Summary of Fit

RSquare	0.284349
RSquare Adj	0.272806
Root Mean Square Error	0.326413
Mean of Response	0.410705
Observations (or Sum Wgts)	64

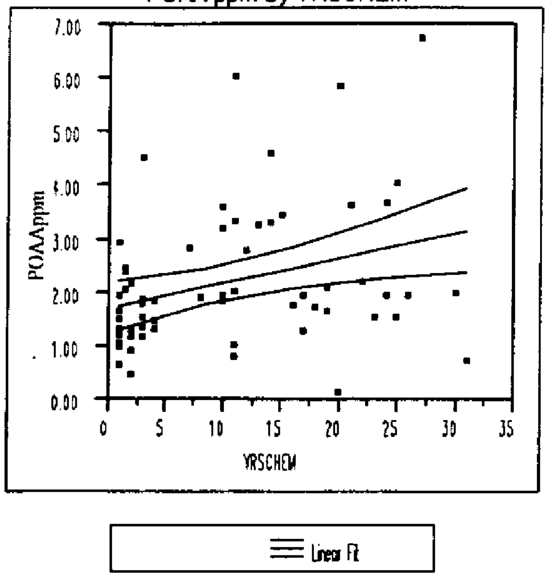
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.6246883	2.62469	24.6344
Error	62	6.6058219	0.10655	Prob>F
C Total	63	9.2305102		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1791447	0.061979	2.89	0.0053	0.0552502	0.3030391
YRSCHEM	0.0224713	0.004527	4.96	<.0001	0.013421	0.0315217

All Participants
Chemical Operators
POAA ppm By YRSCHEM



Linear Fit
POAAppm = 1.71456 + 0.04674 YRSCHEM

Summary of Fit

RSquare	0.101987
RSquare Adj	0.087503
Root Mean Square Error	1.269983
Mean of Response	2.196234
Observations (or Sum Wgts)	64

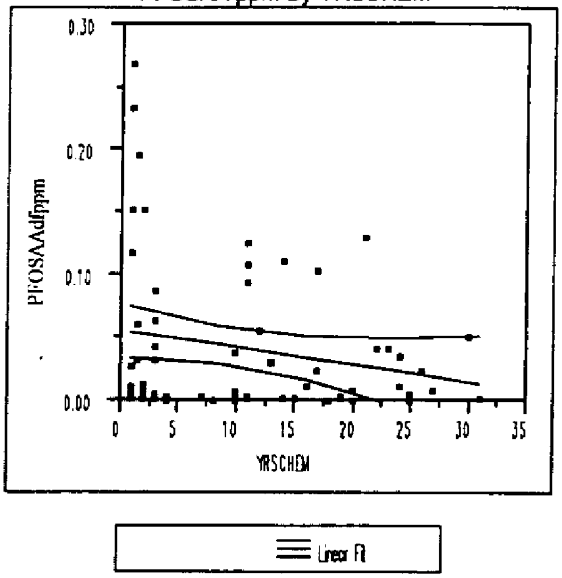
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	11.35666	11.3567	7.0413
Error	62	99.99717	1.6129	Prob>F
C Total	63	111.35384		0.0101

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.7145638	0.241143	7.11	<.0001	1.2325247	2.1966029
YRSCHEM	0.0467429	0.017615	2.65	0.0101	0.0115305	0.0819552

All Participants
Chemical Operators
PFOSAA ppm By YRSCHEM



Linear Fit

PFOSAAdfppm = 0.05584 – 0.00136 YRSCHEM

Summary of Fit

RSquare	0.042288
RSquare Adj	0.026841
Root Mean Square Error	0.059297
Mean of Response	0.041812
Observations (or Sum Wgts)	64

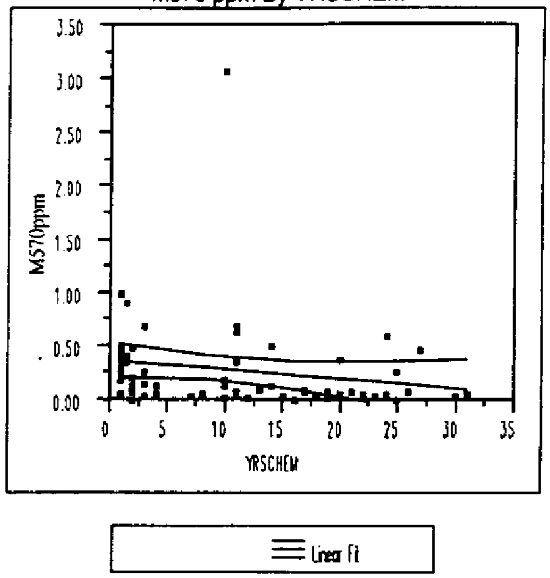
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00962588	0.009626	2.7376
Error	62	0.21799991	0.003516	Prob>F
C Total	63	0.22762579		0.1031

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0558352	0.011259	4.96	<.0001	0.0333282	0.0783421
YRSCHEM	-0.001361	0.000822	-1.65	0.1031	-0.003005	0.0002833

All Participants
Chemical Operators
M570 ppm By YRSCHEM



Linear Fit

M570ppm = 0.37266 – 0.00856 YRSCHEM

Summary of Fit

RSquare	0.031978
RSquare Adj	0.016364
Root Mean Square Error	0.431404
Mean of Response	0.28442
Observations (or Sum Wgts)	64

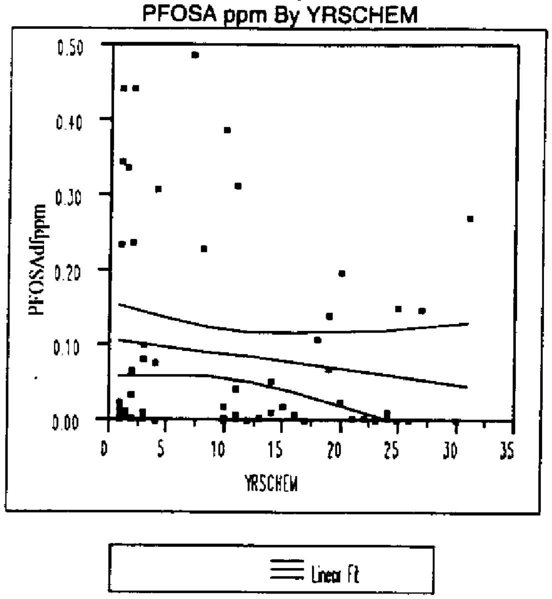
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.381171	0.381171	2.0481
Error	62	11.538802	0.186110	Prob>F
C Total	63	11.919973		0.1574

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3726642	0.081915	4.55	<.0001	0.208919	0.5364095
YRSCHEM	-0.008563	0.005984	-1.43	0.1574	-0.020525	0.0033979

All Participants
Chemical Operators
PFOSA ppm By YRSCHEM



Linear Fit
PFOSAdfppm = 0.10868 – 0.00198 YRSCHEM
Summary of Fit

RSquare	0.018323
RSquare Adj	0.002489
Root Mean Square Error	0.132746
Mean of Response	0.088272
Observations (or Sum Wgts)	64

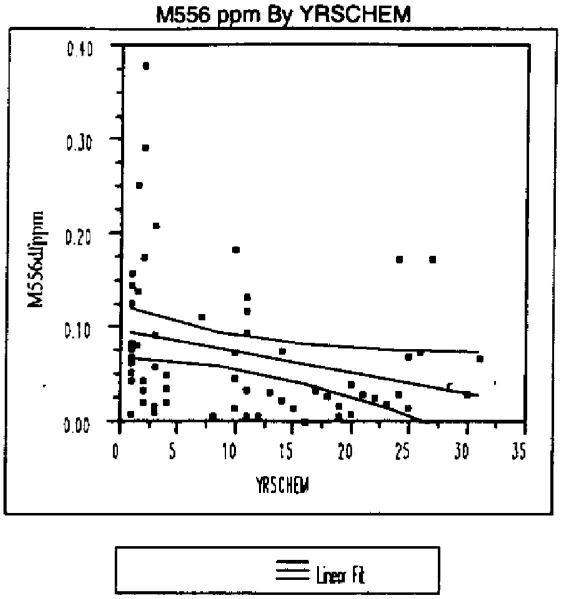
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0203920	0.020392	1.1572
Error	62	1.0925409	0.017622	Prob>F
C Total	63	1.1129329		0.2862

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1086821	0.025206	4.31	<.0001	0.0582964	0.1590678
YRSCHEM	-0.001981	0.001841	-1.08	0.2862	-0.005661	0.0016999

All Participants
Chemical Operators
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = 0.09703 – 0.00222 YRSCHEM

Summary of Fit

RSquare	0.072552
RSquare Adj	0.057593
Root Mean Square Error	0.072643
Mean of Response	0.074167
Observations (or Sum Wgts)	64

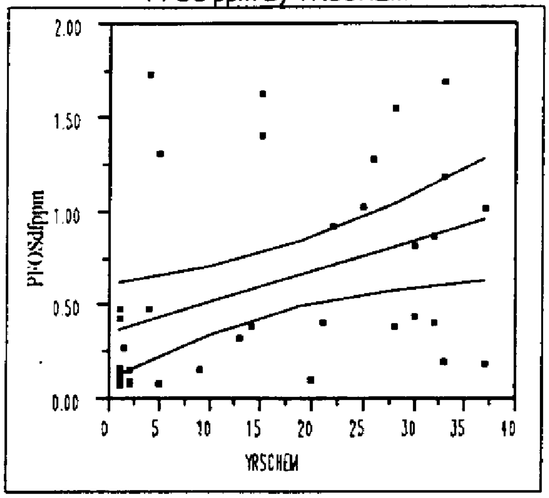
Analysis of Variance

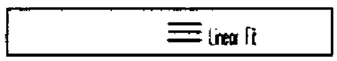
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.02559413	0.025594	4.8501
Error	62	0.32717681	0.005277	Prob>F
C Total	63	0.35277094		0.0314

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0970334	0.013793	7.03	<.0001	0.0694607	0.1246062
YRSCHEM	-0.002219	0.001008	-2.20	0.0314	-0.004233	-0.000205

All Participants
Engineer/Lab
PFOS ppm By YRSCHEM





Linear Fit
PFOSdfppm = 0.36243 + 0.01624 YRSCHEM

Summary of Fit

RSquare	0.158643
RSquare Adj	0.134604
Root Mean Square Error	0.504597
Mean of Response	0.611027
Observations (or Sum Wgts)	37

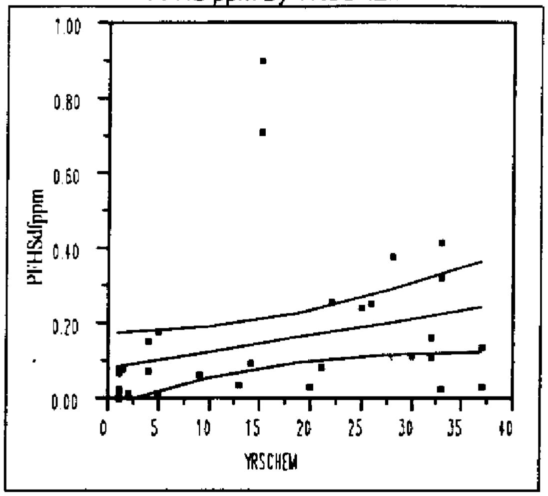
Analysis of Variance

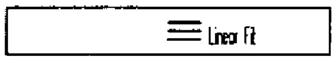
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.680348	1.68035	6.5995
Error	35	8.911651	0.25462	Prob>F
C Total	36	10.591999		0.0146

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3624261	0.127461	2.84	0.0074	0.1036677	0.6211844
YRSCHEM	0.016237	0.00632	2.57	0.0146	0.0034058	0.0290681

All Participants
Engineer/Lab
PFHS ppm By YRSCHEM





Linear Fit

PFHSdfppm = 0.08056 + 0.00441 YRSCHEM

Summary of Fit

RSquare	0.091924
RSquare Adj	0.065979
Root Mean Square Error	0.186981
Mean of Response	0.148053
Observations (or Sum Wgts)	37

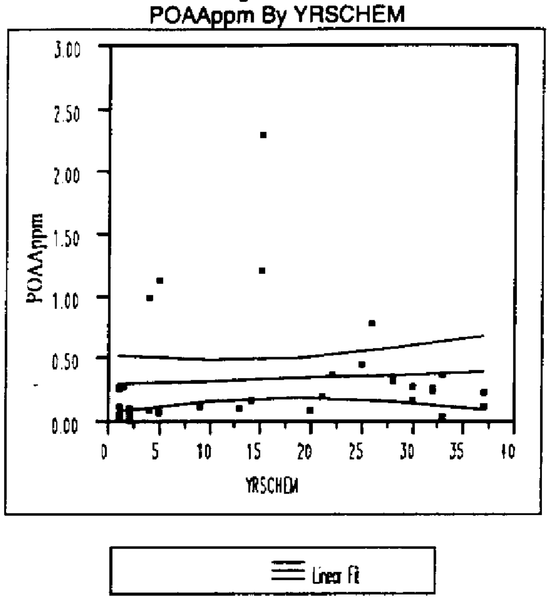
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.1238708	0.123871	3.5430
Error	35	1.2236624	0.034962	Prob>F
C Total	36	1.3475332		0.0681

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0805558	0.047231	1.71	0.0970	-0.015328	0.1764397
YRSCHEM	0.0044085	0.002342	1.88	0.0681	-0.000346	0.0091631

All Participants
Engineer/Lab
POAAppm By YRSCHEM



Linear Fit

POAAppm = 0.30344 + 0.00257 YRSCHEM

Summary of Fit

RSquare	0.005873
RSquare Adj	-0.02253
Root Mean Square Error	0.45092
Mean of Response	0.342765
Observations (or Sum Wgts)	37

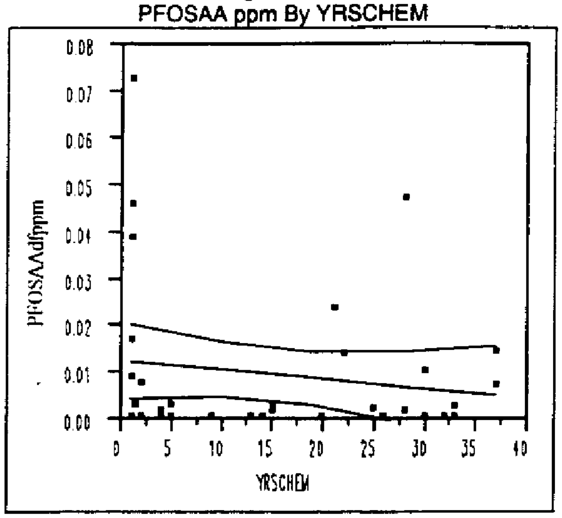
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0420387	0.042039	0.2068
Error	35	7.1165096	0.203329	Prob>F
C Total	36	7.1585483		0.6521

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3034436	0.113902	2.66	0.0116	0.0722111	0.534676
YRSCHEM	0.0025682	0.005648	0.45	0.6521	-0.008898	0.0140344

All Participants
Engineer/Lab
PFOSAA ppm By YRSCHEM



Linear Fit

Linear Fit
PFOSAAdfppm = 0.01271 - 0.0002 YRSCHEM

Summary of Fit

RSquare	0.026565
RSquare Adj	-0.00125
Root Mean Square Error	0.016393
Mean of Response	0.009642
Observations (or Sum Wgts)	37

Analysis of Variance

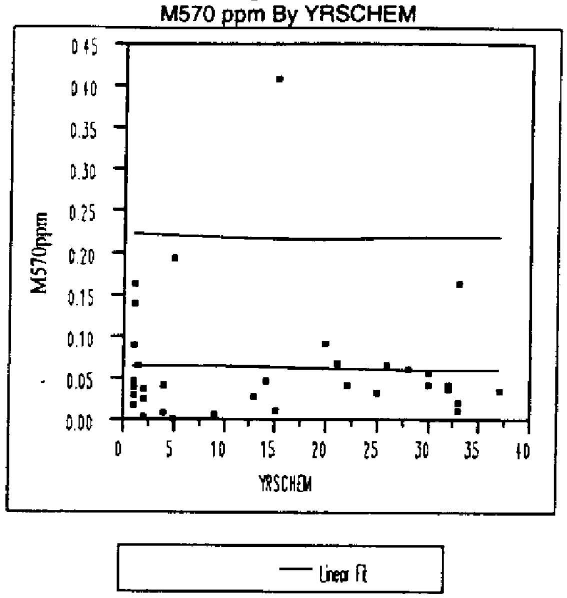
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00025666	0.000257	0.9551
Error	35	0.00940502	0.000269	Prob>F
C Total	36	0.00966167		0.3351

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0127146	0.004141	3.07	0.0041	0.0043085	0.0211207
YRSCHEM	-0.000201	0.000205	-0.98	0.3351	-0.000618	0.0002162

 3MA10050643

All Participants
Engineer/Lab
M570 ppm By YRSCHEM



Linear Fit

M570ppm = 0.06607 – 0.00016 YRSCHEM

Summary of Fit

RSquare	0.000864
RSquare Adj	-0.02768
Root Mean Square Error	0.075116
Mean of Response	0.063565
Observations (or Sum Wgts)	37

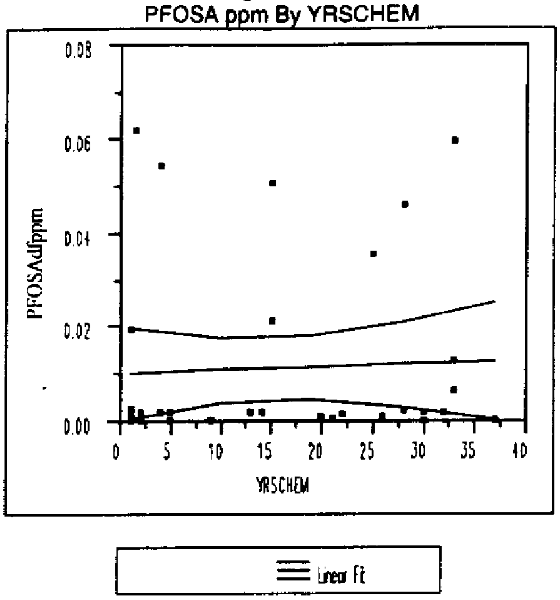
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00017081	0.000171	0.0303
Error	35	0.19748202	0.005642	Prob>F
C Total	36	0.19765282		0.8629

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0660713	0.018974	3.48	0.0014	0.0275519	0.1045907
YRSCHEM	-0.000164	0.000941	-0.17	0.8629	-0.002074	0.0017464

All Participants
Engineer/Lab
PFOSA ppm By YRSCHEM



Linear Fit
PFOSAdfppm = 0.01025 + 0.00007 YRSCHEM

Summary of Fit

RSquare	0.002597
RSquare Adj	-0.0259
Root Mean Square Error	0.019338
Mean of Response	0.011372
Observations (or Sum Wgts)	37

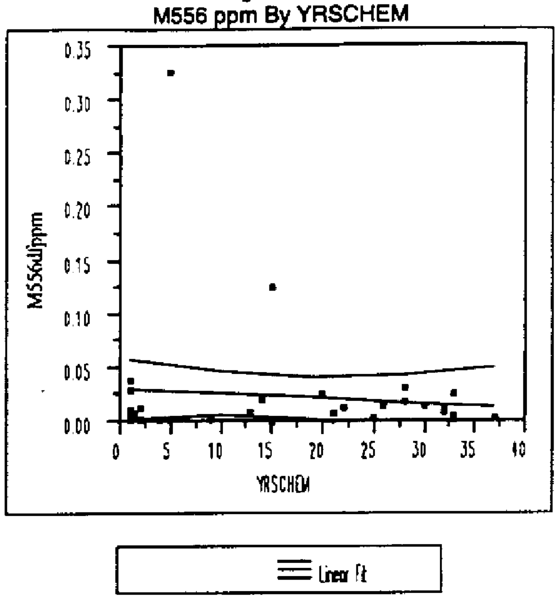
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00003408	0.000034	0.0911
Error	35	0.01308800	0.000374	Prob>F
C Total	36	0.01312208		0.7645

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0102528	0.004885	2.10	0.0431	0.0003365	0.0201692
YRSCHEM	0.0000731	0.000242	0.30	0.7645	-0.000419	0.0005649

All Participants
Engineer/Lab
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = 0.03151 – 0.00049 YRSCHEM

Summary of Fit

RSquare	0.013353
RSquare Adj	-0.01484
Root Mean Square Error	0.056294
Mean of Response	0.024078
Observations (or Sum Wgts)	37

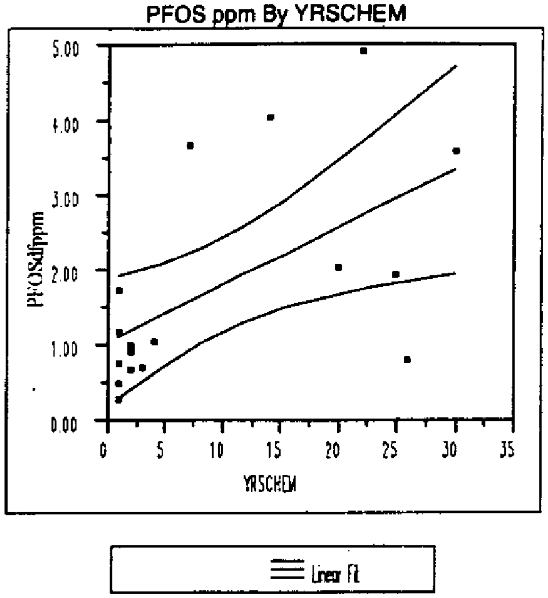
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00150111	0.001501	0.4737
Error	35	0.11091707	0.003169	Prob>F
C Total	36	0.11241818		0.4958

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0315087	0.01422	2.22	0.0333	0.0026409	0.0603766
YRSCHEM	-0.000485	0.000705	-0.69	0.4958	-0.001917	0.0009462

All Participants
Maintenance
PFOS ppm By YRSCHEM



Linear Fit
PFOSdfppm = 1.03905 + 0.07695 YRSCHEM

Summary of Fit

RSquare	0.332684
RSquare Adj	0.288196
Root Mean Square Error	1.203104
Mean of Response	1.772294
Observations (or Sum Wgts)	17

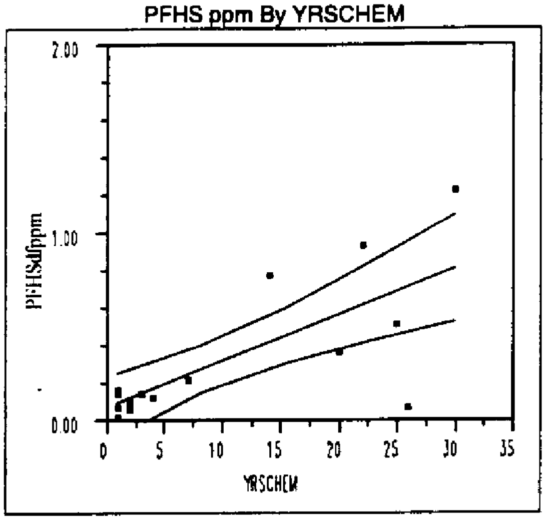
Analysis of Variance

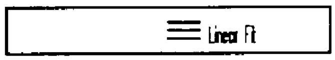
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	10.824249	10.8242	7.4781
Error	15	21.711881	1.4475	Prob>F
C Total	16	32.536130		0.0154

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	1.0390494	0.396284	2.62	0.0192	0.1943936	1.8837052
YRSCHEM	0.0769454	0.028138	2.73	0.0154	0.0169718	0.1369191

All Participants
Maintenance
PFHS ppm By YRSCHEM





Linear Fit

PFHSdfppm = 0.07257 + 0.02482 YRSCHEM

Summary of Fit

RSquare	0.551529
RSquare Adj	0.521631
Root Mean Square Error	0.247055
Mean of Response	0.309053
Observations (or Sum Wgts)	17

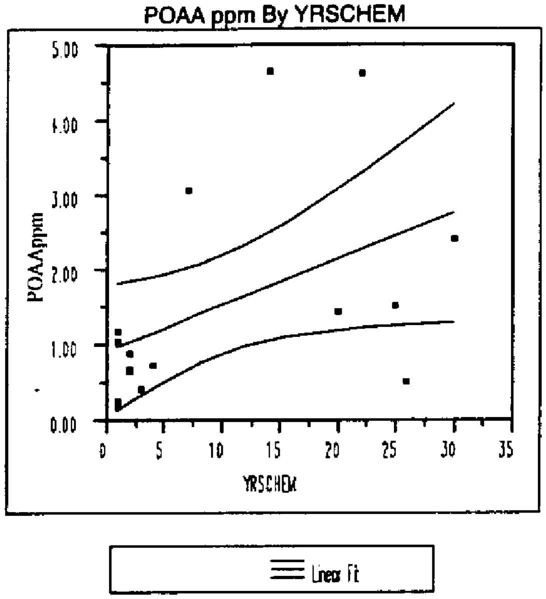
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.1259357	1.12594	18.4470
Error	15	0.9155453	0.06104	Prob>F
C Total	16	2.0414810		0.0006

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0725662	0.081376	0.89	0.3866	-0.100882	0.2460149
YRSCHEM	0.0248165	0.005778	4.29	0.0006	0.012501	0.037132

All Participants
Maintenance
POAA ppm By YRSCHEM



Linear Fit

POAAppm = 0.92588 + 0.06146 YRSCHEM

Summary of Fit

RSquare	0.221317
RSquare Adj	0.169404
Root Mean Square Error	1.272661
Mean of Response	1.511529
Observations (or Sum Wgts)	17

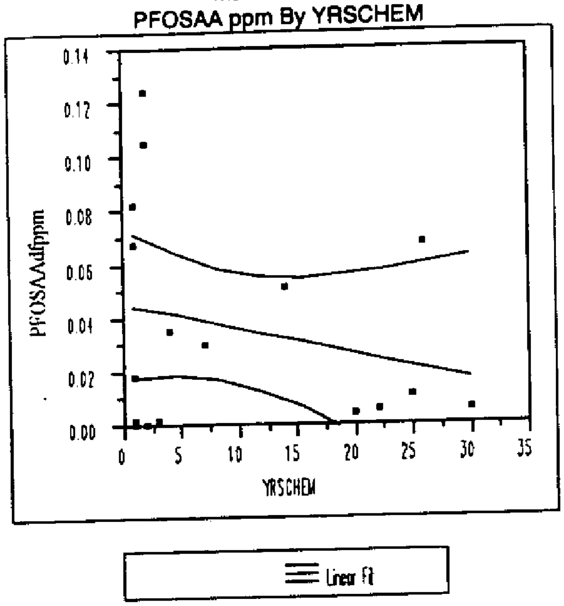
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	6.905100	6.90510	4.2633
Error	15	24.295008	1.61967	Prob>F
C Total	16	31.200108		0.0567

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.9258836	0.419195	2.21	0.0432	0.0323938	1.8193733
YRSCHEM	0.0614567	0.029764	2.06	0.0567	-0.001984	0.1248977

All Participants
Maintenance
PFOSAA ppm By YRSCHEM



Linear Fit

PFOSAAdfppm = 0.04575 - 0.00095 YRSCHEM

Summary of Fit

RSquare	0.064237
RSquare Adj	0.001853
Root Mean Square Error	0.040022
Mean of Response	0.036697
Observations (or Sum Wgts)	17

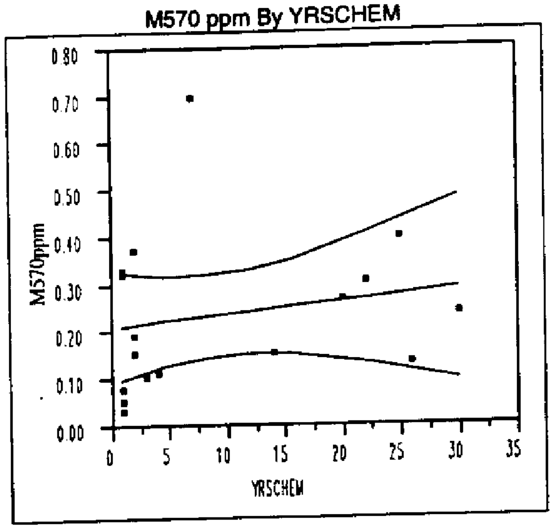
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00164936	0.001649	1.0297
Error	15	0.02402685	0.001602	Prob>F
C Total	16	0.02567621		0.3263

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0457483	0.013183	3.47	0.0034	0.01765	0.0738465
YRSCHEM	-0.00095	0.000936	-1.01	0.3263	-0.002945	0.0010453

All Participants
Maintenance
M570 ppm By YRSCHEM



Linear Fit

Linear Fit

M570ppm = 0.21068 + 0.00273 YRSCHEM

Summary of Fit

RSquare	0.03116
RSquare Adj	-0.03343
Root Mean Square Error	0.168111
Mean of Response	0.236706
Observations (or Sum Wgts)	17

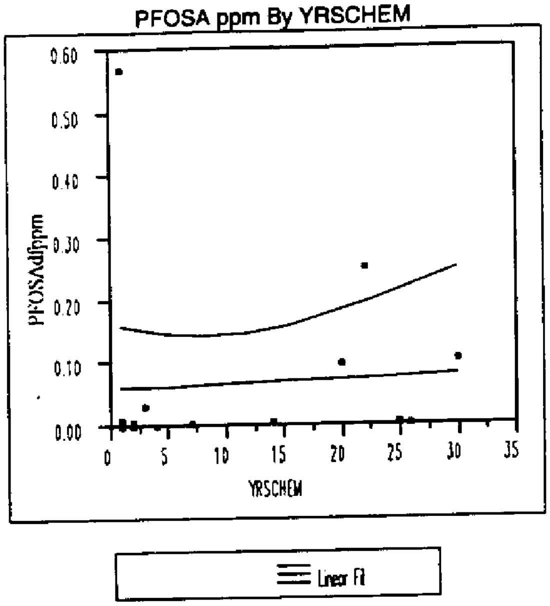
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01363420	0.013634	0.4824
Error	15	0.42392181	0.028261	Prob>F
C Total	16	0.43755601		0.4979

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.2106824	0.055373	3.80	0.0017	0.0926575	0.3287074
YRSCHEM	0.0027309	0.003932	0.69	0.4979	-0.005649	0.0111111

All Participants
Maintenance
PFOSA ppm By YRSCHEM



Linear Fit

PFOSAdfppm = 0.05937 + 0.00069 YRSCHEM

Summary of Fit

RSquare	0.00258
RSquare Adj	-0.06391
Root Mean Square Error	0.149807
Mean of Response	0.065944
Observations (or Sum Wgts)	17

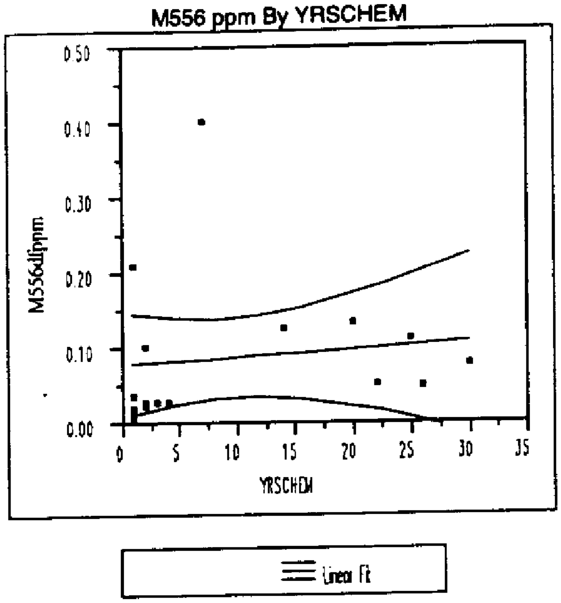
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00087072	0.000871	0.0388
Error	15	0.33663010	0.022442	Prob>F
C Total	16	0.33750082		0.8465

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0593671	0.049344	1.20	0.2476
YRSCHEM	0.0006901	0.003504	0.20	0.8465

All Participants
Maintenance
M556 ppm By YRSCHEM



Linear Fit

M556dfppm = 0.07814 + 0.001 YRSCHEM

Summary of Fit

RSquare	0.011725
RSquare Adj	-0.05416
Root Mean Square Error	0.101656
Mean of Response	0.0877
Observations (or Sum Wgts)	17

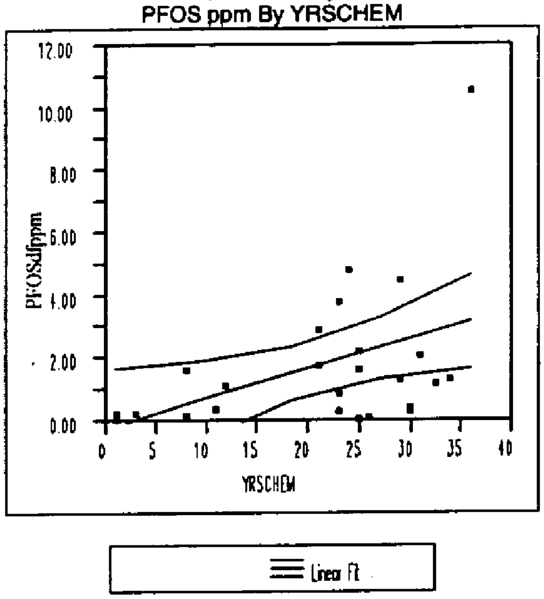
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00183898	0.001839	0.1780
Error	15	0.15500978	0.010334	Prob>F
C Total	16	0.15684876		0.6791

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0781426	0.033484	2.33	0.0339	0.0067735	0.1495118
YRSCHEM	0.0010029	0.002377	0.42	0.6791	-0.004065	0.0060704

All Participants
Supervisors/Mgmt
PFOS ppm By YRSCHEM



Linear Fit

PFOSdfppm = -0.2184 + 0.094 YRSCHEM

Summary of Fit

RSquare	0.194588
RSquare Adj	0.161029
Root Mean Square Error	2.073295
Mean of Response	1.732181
Observations (or Sum Wgts)	26

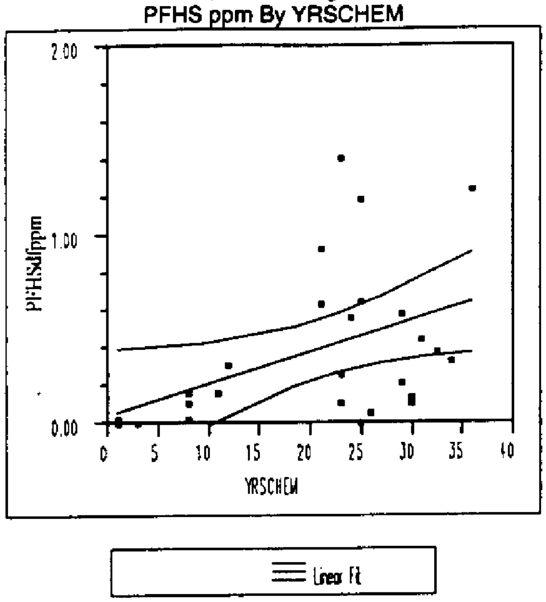
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	24.92474	24.9247	5.7984
Error	24	103.16526	4.2986	Prob>F
C Total	25	128.09000		0.0241

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.218386	0.906363	-0.24	0.8116	-2.089012	1.6522407
YRSCHEM	0.0940032	0.039038	2.41	0.0241	0 0134332	0.1745732

All Participants
Supervisors/Mgmt
PFHS ppm By YRSCHEM



Linear Fit
PFHSdfppm = 0.04486 + 0.01663 YRSCHEM

Summary of Fit

RSquare	0.185071
RSquare Adj	0.151116
Root Mean Square Error	0.378289
Mean of Response	0.389914
Observations (or Sum Wgts)	26

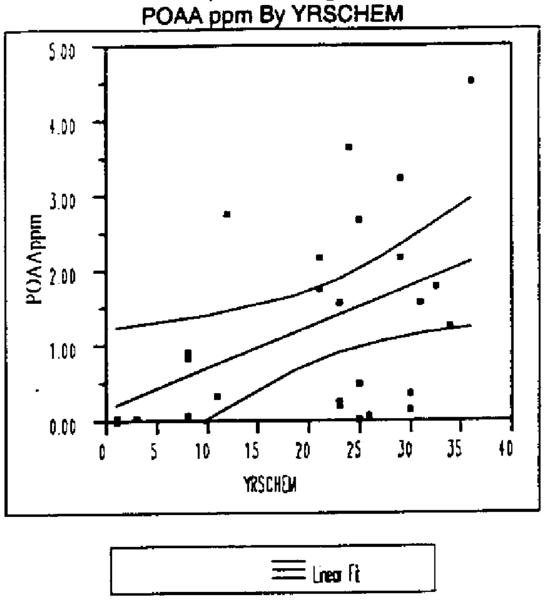
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.7799725	0.779972	5.4504
Error	24	3.4344674	0.143103	Prob>F
C Total	25	4.2144399		0.0283

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0448618	0.165373	0.27	0.7885	-0.296449	0.3861726
YRSCHEM	0.016629	0.007123	2.33	0.0283	0.0019284	0.0313297

All Participants
Supervisors/Mgmt
POAA ppm By YRSCHEM



Linear Fit
POAAppm = 0.17876 + 0.05352 YRSCHEM

Summary of Fit

RSquare	0.193609
RSquare Adj	0.160009
Root Mean Square Error	1.184218
Mean of Response	1.2894
Observations (or Sum Wgts)	26

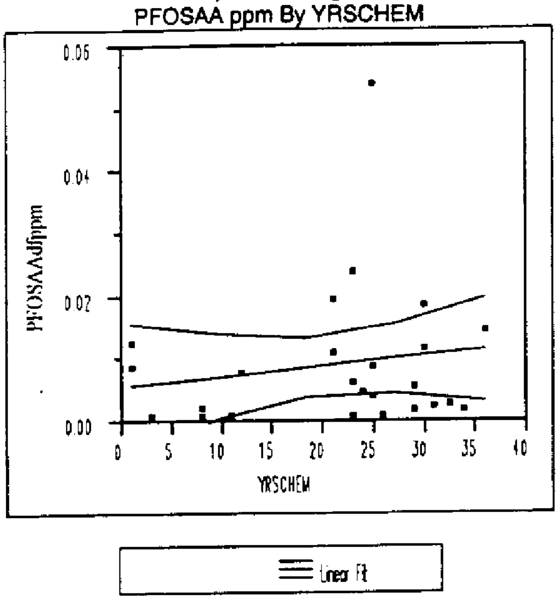
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	8.080800	8.08080	5.7622
Error	24	33.656935	1.40237	Prob>F
C Total	25	41.737735		0.0245

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1787618	0.517694	0.35	0.7329	-0.889697	1.2472201
YRSCHEM	0.0535247	0.022298	2.40	0.0245	0.007505	0.0995444

All Participants
Supervisors/Mgmt
PFOSAA ppm By YRSCHEM



Linear Fit

PFOSAAdfppm = 0.00564 + 0.00016 YRSCHEM

Summary of Fit

RSquare	0.023751
RSquare Adj	-0.01693
Root Mean Square Error	0.011408
Mean of Response	0.009045
Observations (or Sum Wgts)	26

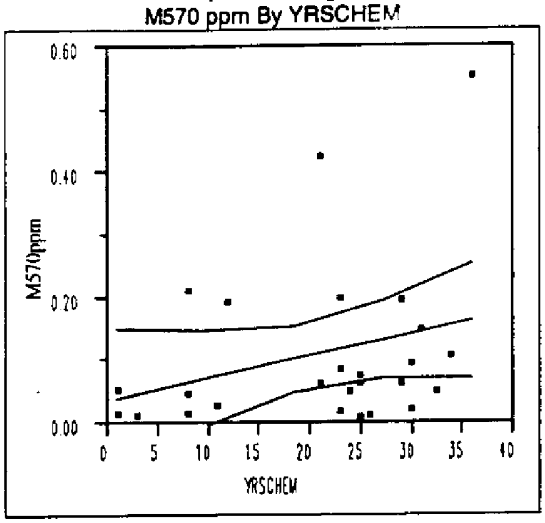
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00007599	0.000076	0.5839
Error	24	0.00312335	0.000130	Prob>F
C Total	25	0.00319934		0.4522

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0056392	0.004987	1.13	0.2693	-0.004654	0.0159319
YRSCHEM	0.0001641	0.000215	0.76	0.4522	-0.000279	0.0006075

All Participants
Supervisors/Mgmt
M570 ppm By YRSCHEM



Linear Fit

Linear Fit
M570ppm = 0.03728 + 0.00349 YRSCHEM

Summary of Fit

RSquare	0.081466
RSquare Adj	0.043194
Root Mean Square Error	0.127205
Mean of Response	0.109788
Observations (or Sum Wgts)	26

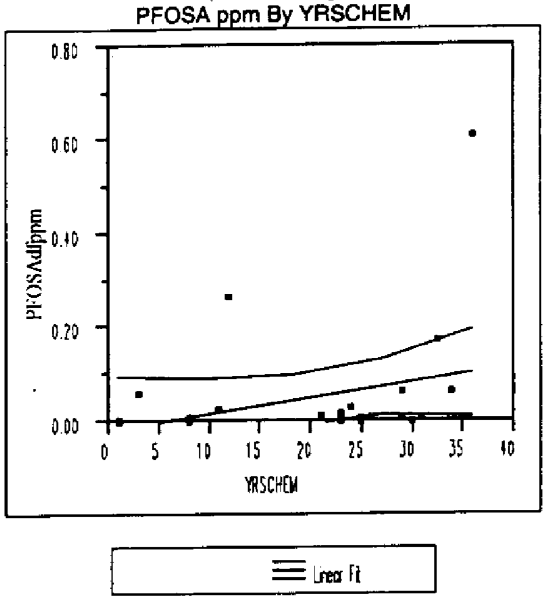
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.03444346	0.034443	2.1286
Error	24	0.38834961	0.016181	Prob>F
C Total	25	0.42279307		0.1575

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0372783	0.055609	0.67	0.5090	-0.077493	0.1520492
YRSCHEM	0.0034945	0.002395	1.46	0.1575	-0.001449	0.0084378

All Participants
Supervisors/Mgmt
PFOSA ppm By YRSCHEM



Linear Fit
PFOSAdfppm = -0.0169 + 0.00333 YRSCHEM

Summary of Fit

RSquare	0.075283
RSquare Adj	0.036753
Root Mean Square Error	0.126709
Mean of Response	0.052267
Observations (or Sum Wgts)	26

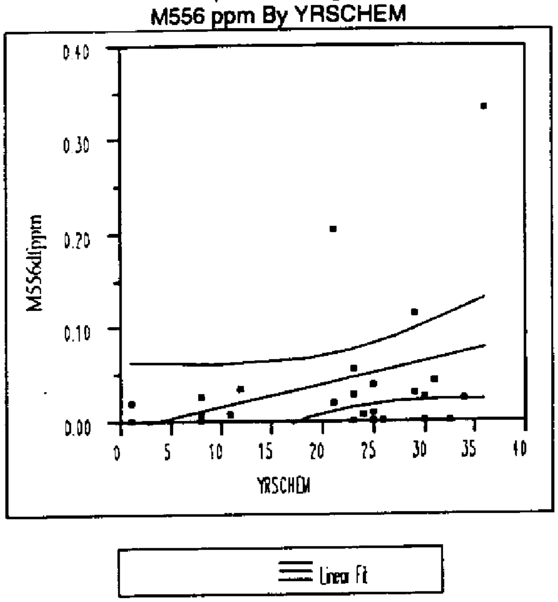
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.03137008	0.031370	1.9539
Error	24	0.38532631	0.016055	Prob>F
C Total	25	0.41669639		0.1750

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.016933	0.055392	-0.31	0.7625	-0.131256	0.0973903
YRSCHEM	0.0033349	0.002386	1.40	0.1750	-0.001589	0.008259

All Participants
Supervisors/Mgmt
M556 ppm By YRSCHEM



Linear Fit
M556dfppm = -0.0067 + 0.00235 YRSCHEM

Summary of Fit

RSquare	0.101017
RSquare Adj	0.061931
Root Mean Square Error	0.072994
Mean of Response	0.04378
Observations (or Sum Wgts)	25

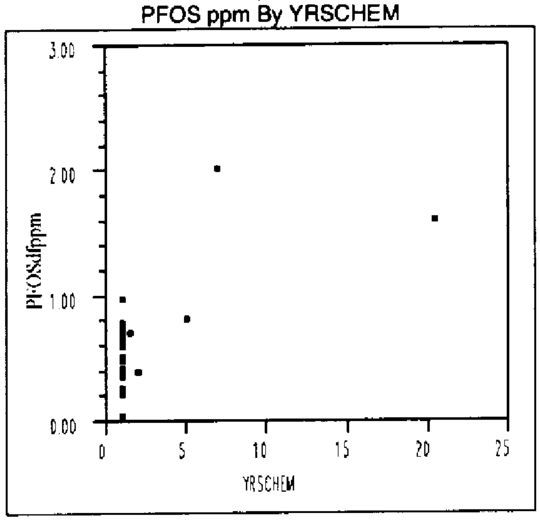
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.01377030	0.013770	2.5845
Error	23	0.12254662	0.005328	Prob>F
C Total	24	0.13631692		0.1216

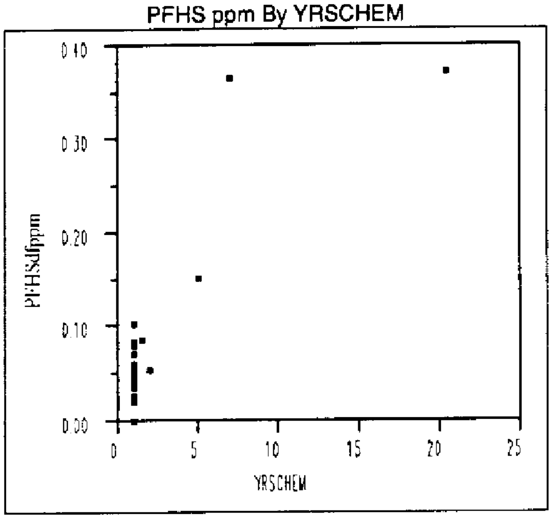
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.006656	0.034603	-0.19	0.8491	-0.078239	0.0649258
YRSCHEM	0.0023503	0.001462	1.61	0.1216	-0.000674	0.0053745

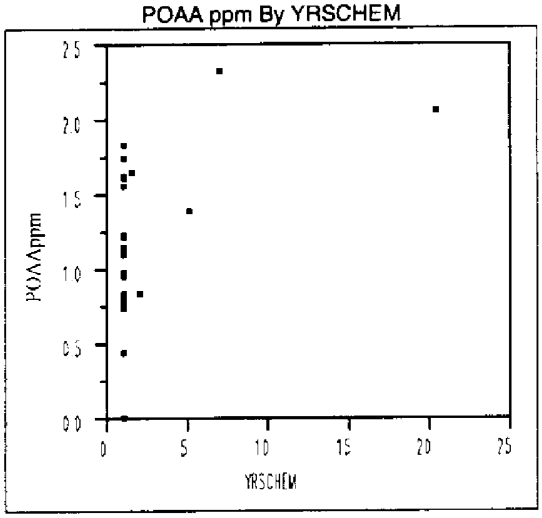
All Participants
Mill Operators
PFOS ppm By YRSCHEM



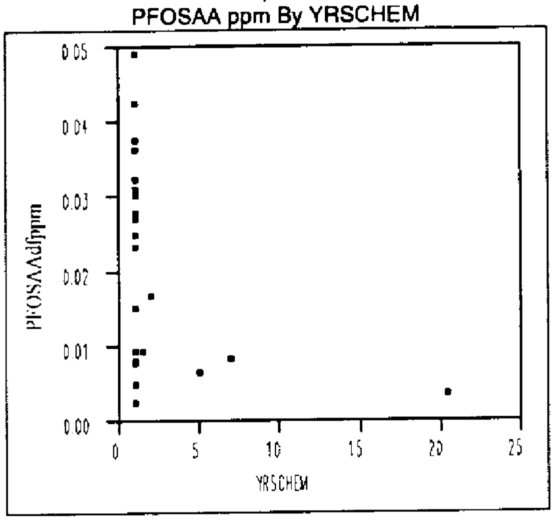
All Participants
Mill Operators
PFHS ppm By YRSCHEM



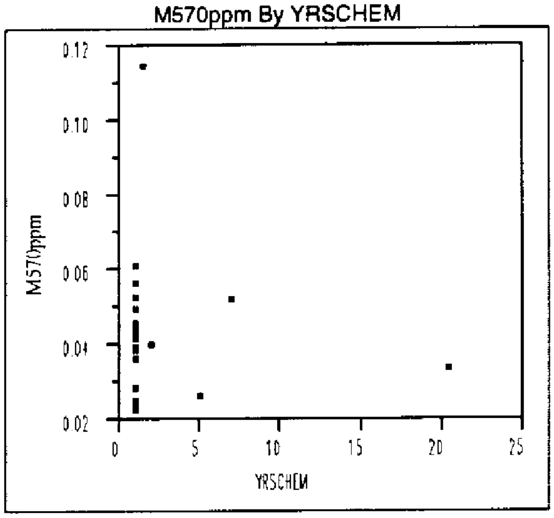
All Participants
Mill Operators
POAA ppm By YRSCHEM



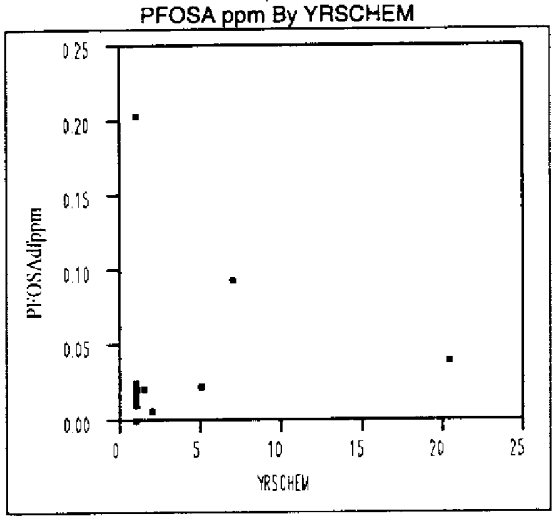
All Participants
Mill Operators
PFOSAA ppm By YRSCHEM



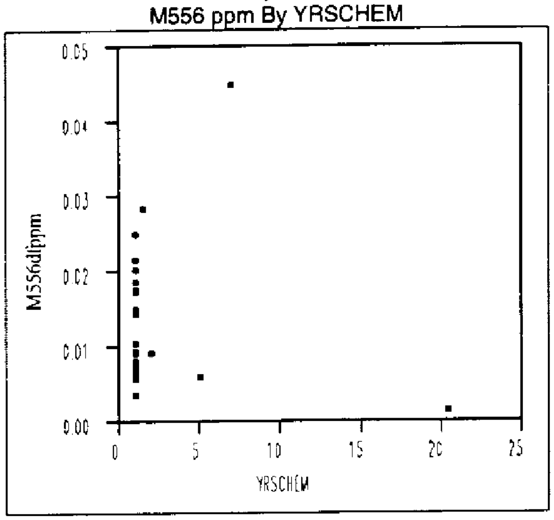
All Participants
Mill Operators
M570ppm By YRSCHEM



All Participants
Mill Operators
PFOSA ppm By YRSCHEM



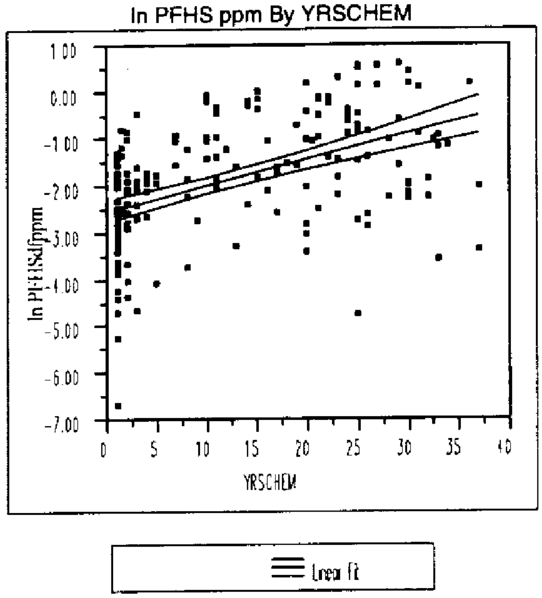
All Participants
Mill Operators
M556 ppm By YRSCHEM



Appendix H

Scatterplots and regression equations for fluorochemicals (natural log transformation) by years worked in chemical (YRSCHEM) for all chemical participants (n = 187) and for two current job categories (chemcial operators and engineer/lab)

All Participants
ln PFHS ppm By YRSCHEM



Linear Fit
ln PFHSdfppm = -2.5211 + 0.05519 YRSCHEM

Summary of Fit

RSquare	0.226387
RSquare Adj	0.222205
Root Mean Square Error	1.150356
Mean of Response	-1.84074
Observations (or Sum Wgts)	187

Analysis of Variance

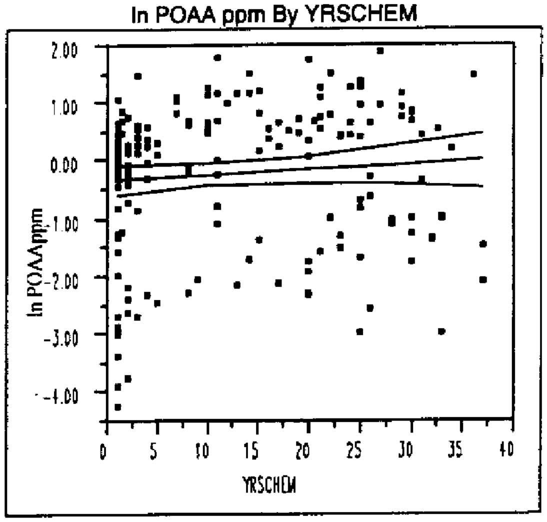
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	71.64131	71.6413	54.1376
Error	185	244.81410	1.3233	Prob>F
C Total	186	316.45541		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.52111	0.125008	-20.17	<.0001	-2.767738	-2.274482
YRSCHEM	0.055185	0.0075	7.36	<.0001	0.040388	0.0699821

 3MA10050669

All Participants
ln POAA ppm By YRSCHEM



Linear Fit

Linear Fit
ln POAAppm = -0.3289 + 0.00943 YRSCHEM

Summary of Fit

RSquare	0.006732
RSquare Adj	0.001363
Root Mean Square Error	1.291882
Mean of Response	-0.21266
Observations (or Sum Wgts)	187

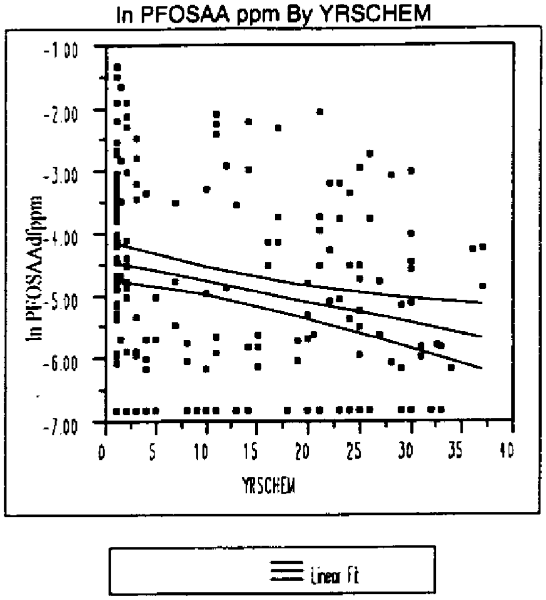
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.09272	2.09272	1.2539
Error	185	308.75765	1.66896	Prob>F
C Total	186	310.85036		0.2643

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.328943	0.140388	-2.34	0.0202	-0.605913	-0.051973
YRSCHEM	0.0094318	0.008423	1.12	0.2643	-0.007186	0.0260493

All Participants
ln PFOSAA ppm By YRSCHEM



Linear Fit

ln PFOSAAdfppm = -4.4107 – 0.03347 YRSCHEM

Summary of Fit

RSquare	0.06056
RSquare Adj	0.055482
Root Mean Square Error	1.486622
Mean of Response	-4.82337
Observations (or Sum Wgts)	187

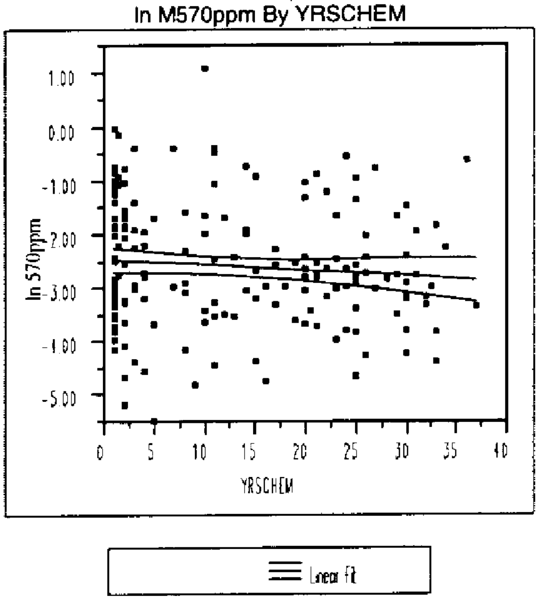
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	26.35653	26.3565	11.9258
Error	185	408.85842	2.2100	Prob>F
C Total	186	435.21495		0.0007

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.410692	0.16155	-27.30	<.0001	-4.729413	-4.091972
YRSCHEM	-0.033472	0.009693	-3.45	0.0007	-0.052595	-0.01435

All Participants
ln M570ppm By YRSCHEM



Linear Fit

ln 570ppm = -2.4506 – 0.00984 YRSCHEM

Summary of Fit

RSquare	0.009202
RSquare Adj	0.003846
Root Mean Square Error	1.151312
Mean of Response	-2.57193
Observations (or Sum Wgts)	187

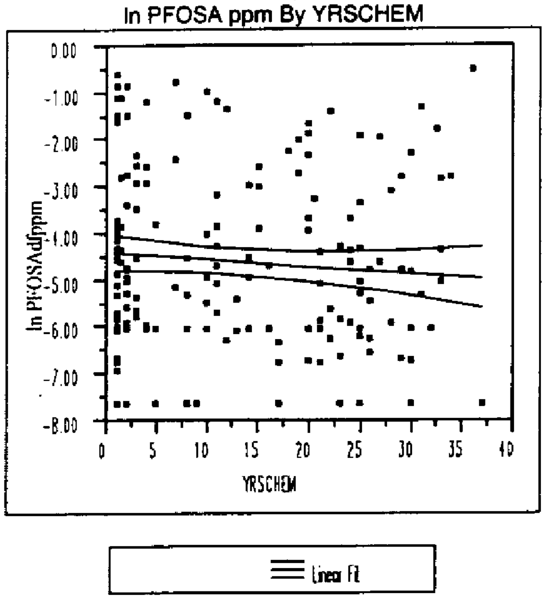
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.27743	2.27743	1.7181
Error	185	245.22096	1.32552	Prob>F
C Total	186	247.49839		0.1916

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.450623	0.125112	-19.59	<.0001	-2.697456	-2.20379
YRSCHEM	-0.009839	0.007506	-1.31	0.1916	-0.024649	0.0049701

All Participants
ln PFOSA ppm By YRSCHEM



Linear Fit

ln PFOSAdfppm = -4.4035 - 0.01431 YRSCHEM

Summary of Fit

RSquare	0.007678
RSquare Adj	0.002314
Root Mean Square Error	1.834221
Mean of Response	-4.57987
Observations (or Sum Wgts)	187

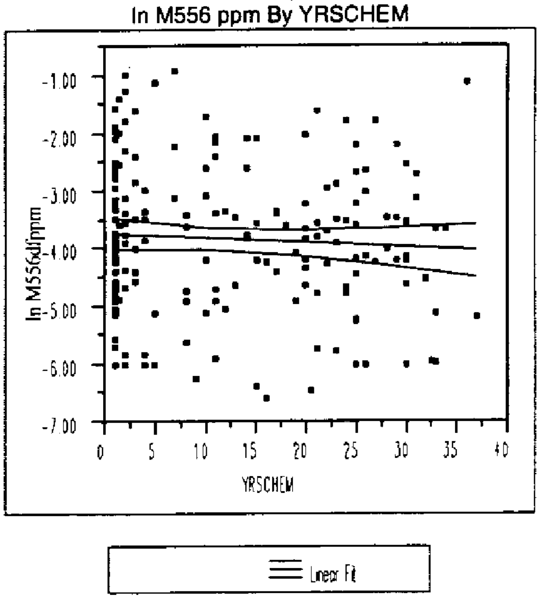
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.81599	4.81599	1.4315
Error	185	622.40775	3.36437	Prob>F
C Total	186	627.22374		0.2331

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.403463	0.199323	-22.09	<.0001	-4.796706	-4.01022
YRSCHEM	-0.014308	0.011959	-1.20	0.2331	-0.037902	0.0092855

All Participants
ln M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -3.7337 – 0.00771 YRSCHEM

Summary of Fit

RSquare	0.00447
RSquare Adj	-0.00094
Root Mean Square Error	1.298323
Mean of Response	-3.82913
Observations (or Sum Wgts)	186

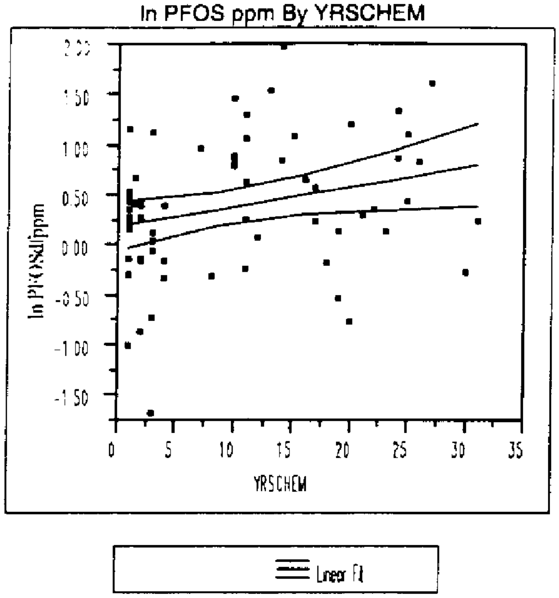
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.39270	1.39270	0.8262
Error	184	310.15820	1.68564	Prob>F
C Total	185	311.55090		0.3646

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.733702	0.141718	-26.35	<.0001	-4 013306	-3.454098
YRSCHEM	-0.007709	0.008481	-0.91	0.3646	-0 024441	0.0090235

All Participants
Chemical Operators
ln PFOS ppm By YRSCHEM



Linear Fit

ln PFOSdfppm = 0.19093 + 0.01954 YRSCHEM

Summary of Fit

RSquare	0.067842
RSquare Adj	0.052807
Root Mean Square Error	0.663197
Mean of Response	0.392284
Observations (or Sum Wgts)	64

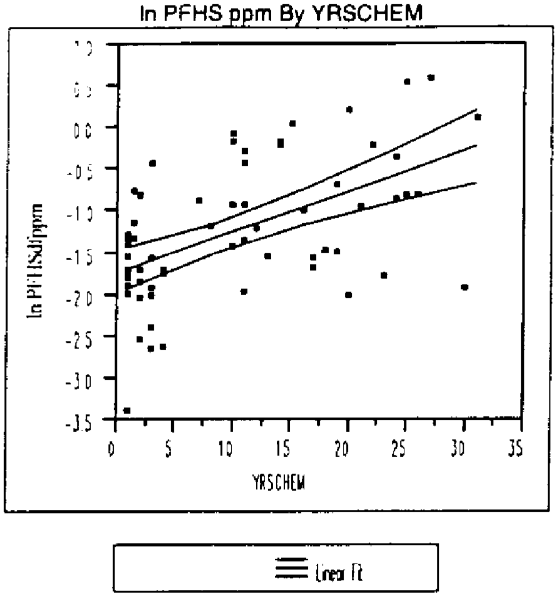
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.984648	1.98465	4.5123
Error	62	27.269497	0.43983	Prob>F
C Total	63	29.254145		0.0376

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.1909269	0.125927	1.52	0.1346	-0.060798	0.4426522
YRSCHEM	0.0195403	0.009199	2.12	0.0376	0.0011521	0.0379285

All Participants
Chemical Operators
ln PFHS ppm By YRSCHEM



Linear Fit

ln PFHSdfppm = -1.7282 + 0.04829 YRSCHEM

Summary of Fit

RSquare	0.28459
RSquare Adj	0.273051
Root Mean Square Error	0.701066
Mean of Response	-1.23054
Observations (or Sum Wgts)	64

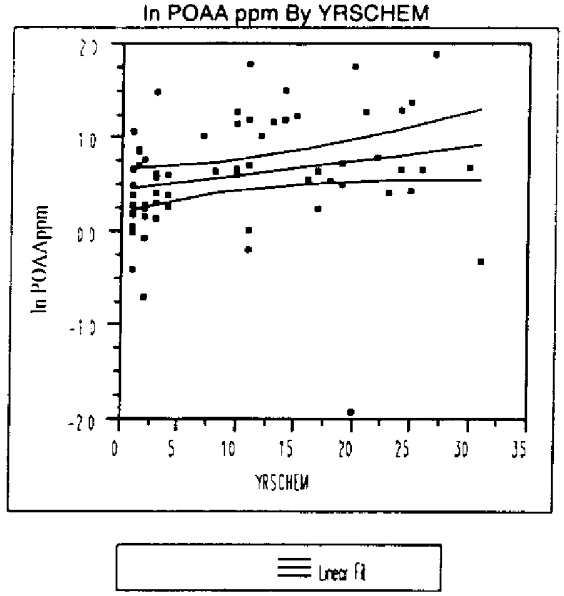
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	12.122007	12.1220	24.6636
Error	62	30.472595	0.4915	Prob>F
C Total	63	42.594602		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.72818	0.133118	-12.98	<.0001	-1.994279	-1.462081
YRSCHEM	0.0482922	0.009724	4.97	<.0001	0.028854	0.0677304

All Participants
Chemical Operators
ln POAA ppm By YRSCHEM



Linear Fit

ln POAAppm = 0.45333 + 0.01564 YRSCHEM

Summary of Fit

RSquare	0.051828
RSquare Adj	0.036535
Root Mean Square Error	0.612605
Mean of Response	0.614523
Observations (or Sum Wgts)	64

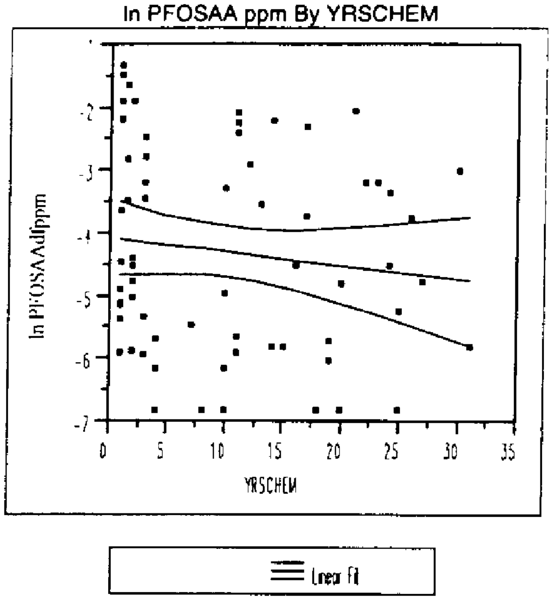
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.271823	1.27182	3.3890
Error	62	23.267630	0.37528	Prob>F
C Total	63	24.539453		0.0704

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.4533333	0.116321	3.90	0.0002	0.220811	0.6858555
YRSCHEM	0.0156424	0.008497	1.84	0.0704	-0.001343	0.0326278

All Participants
Chemical Operators
ln PFOSAA ppm By YRSCHEM



Linear Fit

ln PFOSAAdfppm = -4.0532 – 0.02268 YRSCHEM

Summary of Fit

RSquare	0.016184
RSquare Adj	0.000316
Root Mean Square Error	1.619017
Mean of Response	-4.28694
Observations (or Sum Wgts)	64

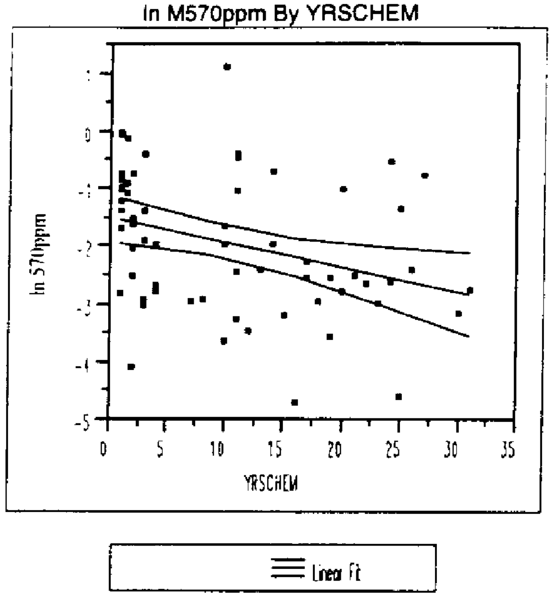
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.67335	2.67335	1.0199
Error	62	162.51531	2.62121	Prob>F
C Total	63	165.18867		0.3165

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.053244	0.307418	-13.18	<.0001	-4.667764	-3.438725
YRSCHEM	-0.022679	0.022456	-1.01	0.3165	-0.067569	0.0222112

All Participants
Chemical Operators
ln M570ppm By YRSCHEM



Linear Fit
ln 570ppm = -1.5009 – 0.04316 YRSCHEM

Summary of Fit

RSquare	0.10729
RSquare Adj	0.092891
Root Mean Square Error	1.139966
Mean of Response	-1.94564
Observations (or Sum Wgts)	64

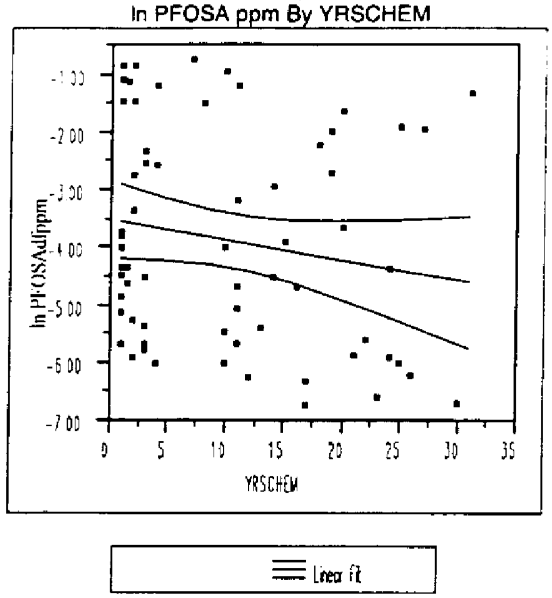
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	9.683322	9.68332	7.4514
Error	62	80.570389	1.29952	Prob>F
C Total	63	90.253710		0.0082

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.500868	0.216456	-6.93	<.0001	-1.933557	-1.068179
YRSCHEM	-0.043162	0.015812	-2.73	0.0082	-0.074769	-0.011555

All Participants
Chemical Operators
ln PFOSA ppm By YRSCHEM



Linear Fit
ln PFOSAdfppm = -3.4933 – 0.03575 YRSCHEM

Summary of Fit

RSquare	0.030317
RSquare Adj	0.014677
Root Mean Square Error	1.851004
Mean of Response	-3.8617
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	6.64144	6.64144	1.9384
Error	62	212.42545	3.42622	Prob>F
C Total	63	219.06689		0.1688

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.49335	0.351467	-9.94	<.0001	-4.195923	-2.790777
YRSCHEM	-0.035745	0.025674	-1.39	0.1688	-0.087068	0.0155766

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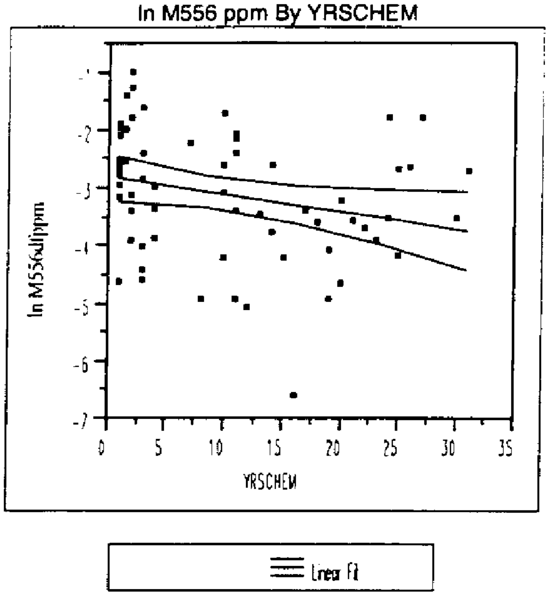
All Participants
Chemical Operators
ln M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -2.7891 – 0.03042 YRSCHEM

Summary of Fit

RSquare	0.063375
RSquare Adj	0.048268
Root Mean Square Error	1.070608
Mean of Response	-3.10248
Observations (or Sum Wgts)	64

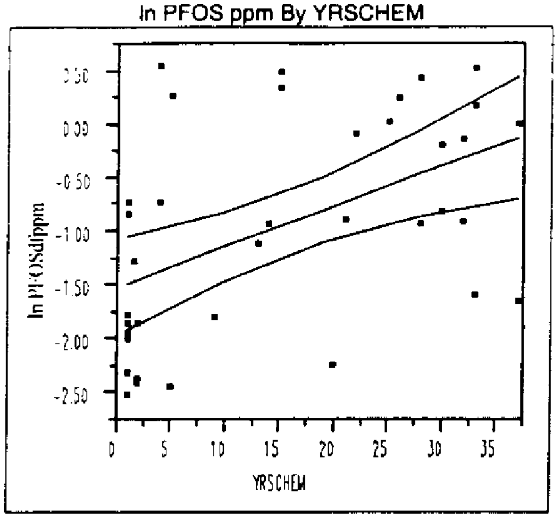
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.808428	4.80843	4.1951
Error	62	71.064468	1.14620	Prob>F
C Total	63	75.872896		0.0448

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.789057	0.203286	-13.72	<.0001	-3.19542	-2.382693
YRSCHEM	-0.030415	0.01485	-2.05	0.0448	-0.0601	-0.000731

All Participants
Engineer/Lab
ln PFOS ppm By YRSCHEM



Linear Fit

Linear Fit

ln PFOSdfppm = -1.5212 + 0.03794 YRSCHEM

Summary of Fit

RSquare	0.250379
RSquare Adj	0.228961
Root Mean Square Error	0.885804
Mean of Response	-0.94033
Observations (or Sum Wgts)	37

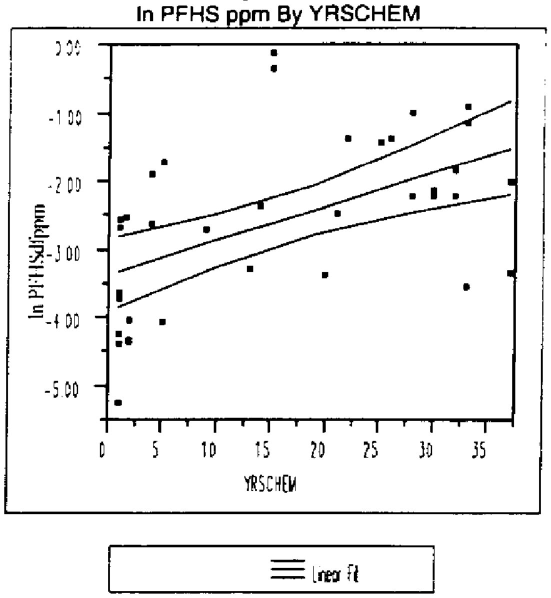
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	9.172752	9.17275	11.6903
Error	35	27.462686	0.78465	Prob>F
C Total	36	36.635438		0.0016

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.521161	0.223754	-6.80	<.0001	-1.975403	-1.06692
YRSCHEM	0.0379363	0.011095	3.42	0.0016	0.0154116	0.060461

All Participants
Engineer/Lab
ln PFHS ppm By YRSCHEM



Linear Fit
ln PFHSdfppm = -3.3667 + 0.05024 YRSCHEM

Summary of Fit

RSquare	0.291558
RSquare Adj	0.271317
Root Mean Square Error	1.056855
Mean of Response	-2.5975
Observations (or Sum Wgts)	37

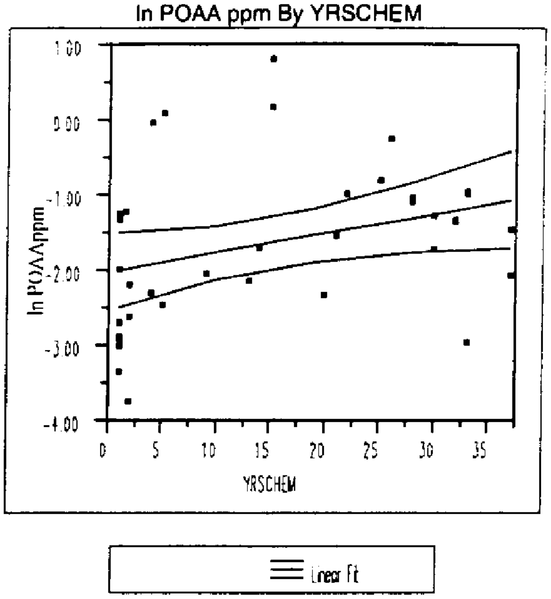
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	16.088669	16.0887	14.4042
Error	35	39.092987	1.1169	Prob>F
C Total	36	55.181656		0.0006

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.366746	0.266961	-12.61	<.0001	-3.908703	-2.824789
YRSCHEM	0.0502418	0.013238	3.80	0.0006	0.0233675	0.0771161

All Participants
Engineer/Lab
ln POAA ppm By YRSCHEM



Linear Fit
ln POAAppm = -2.0155 + 0.02576 YRSCHEM

Summary of Fit

RSquare	0.107494
RSquare Adj	0.081994
Root Mean Square Error	1.001589
Mean of Response	-1.62112
Observations (or Sum Wgts)	37

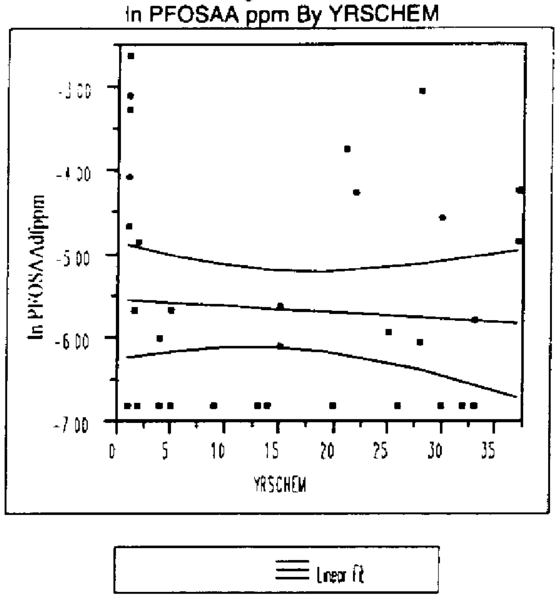
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.228818	4.22882	4.2154
Error	35	35.111285	1.00318	Prob>F
C Total	36	39.340103		0.0476

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.015494	0.253001	-7.97	<.0001	-2.52911	-1.501878
YRSCHEM	0.0257581	0.012546	2.05	0.0476	0.0002892	0.0512271

All Participants
Engineer/Lab
ln PFOSAA ppm By YRSCHEM



Linear Fit

ln PFOSAAdfppm = -5.5422 – 0.00745 YRSCHEM

Summary of Fit

RSquare	0.005419
RSquare Adj	-0.023
Root Mean Square Error	1.362132
Mean of Response	-5.65628
Observations (or Sum Wgts)	37

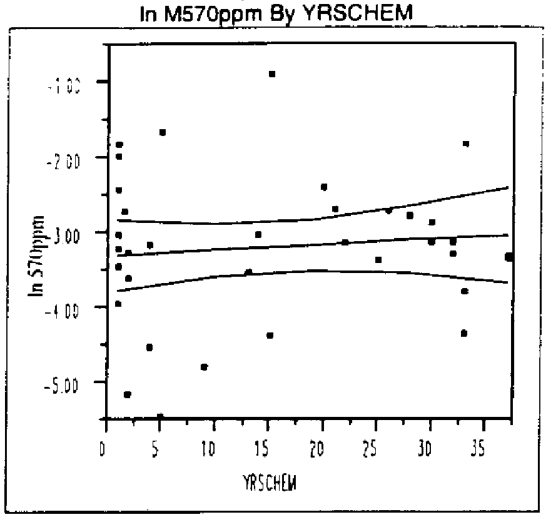
Analysis of Variance

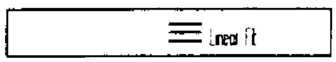
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.353853	0.35385	0.1907
Error	35	64.939165	1.85540	Prob>F
C Total	36	65.293017		0.6650

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.542201	0.344074	-16.11	<.0001	-6 240704	-4.843697
YRSCHEM	-0.007451	0.017062	-0.44	0.6650	-0 042088	0.027186

All Participants
Engineer/Lab
ln M570ppm By YRSCHEM





Linear Fit
ln 570ppm = -3.3086 + 0.00738 YRSCHEM

Summary of Fit

RSquare	0.010486
RSquare Adj	-0.01779
Root Mean Square Error	0.967617
Mean of Response	-3.19558
Observations (or Sum Wgts)	37

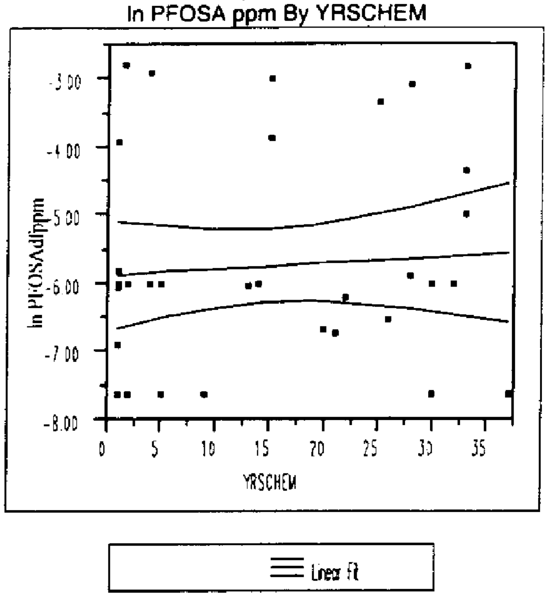
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.347256	0.347256	0.3709
Error	35	32.769885	0.936282	Prob>F
C Total	36	33.117141		0.5465

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.308597	0.24442	-13.54	<.0001	-3 804792	-2.812402
YRSCHEM	0.0073812	0.01212	0.61	0.5465	-0 017224	0.0319863

All Participants
Engineer/Lab
ln PFOSA ppm By YRSCHEM



Linear Fit

ln PFOSAdfppm = -5.8688 + 0.0086 YRSCHEM

Summary of Fit

RSquare	0.005342
RSquare Adj	-0.02308
Root Mean Square Error	1.583297
Mean of Response	-5.7372
Observations (or Sum Wgts)	37

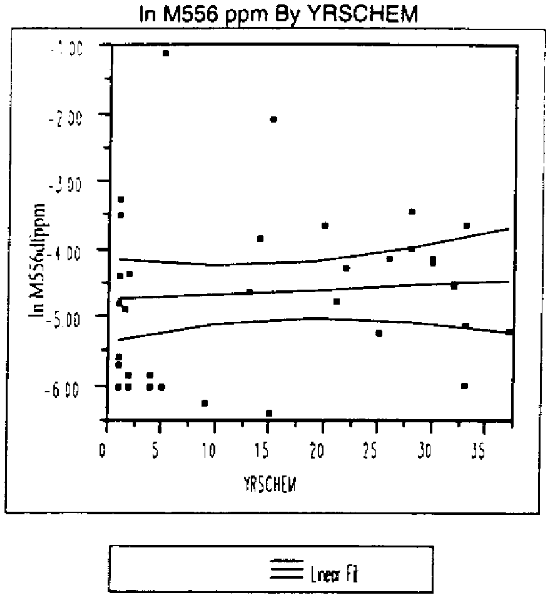
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.471187	0.47119	0.1880
Error	35	87.739016	2.50683	Prob>F
C Total	36	88.210203		0.6673

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.868846	0.39994	-14.67	<.0001	-6.680763	-5.056929
YRSCHEM	0.0085981	0.019832	0.43	0.6673	-0.031663	0.048859

All Participants
Engineer/Lab
ln M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -4.7368 + 0.00765 YRSCHEM

Summary of Fit

RSquare	0.00737
RSquare Adj	-0.02099
Root Mean Square Error	1.198158
Mean of Response	-4.61966
Observations (or Sum Wgts)	37

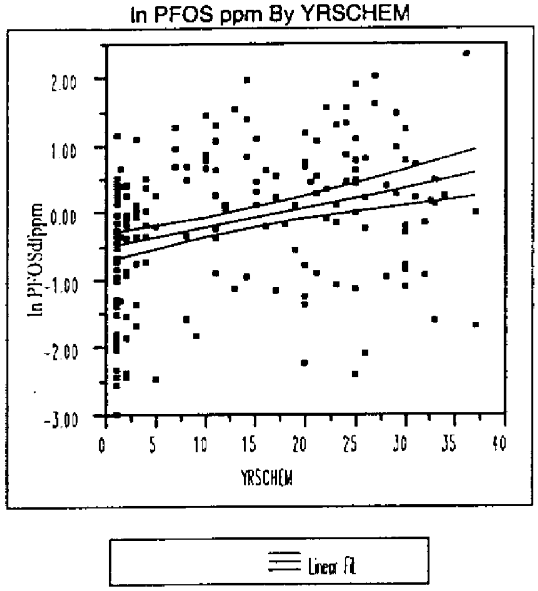
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.373036	0.37304	0.2598
Error	35	50.245432	1.43558	Prob>F
C Total	36	50.618468		0.6134

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.736793	0.302654	-15.65	<.0001	-5.35121	-4.122375
YRSCHEM	0.0076503	0.015008	0.51	0.6134	-0 022817	0.0381178

All Participants
ln PFOS ppm By YRSCHEM



Linear Fit
ln PFOSdfppm = -0.493 + 0.02935 YRSCHEM

Summary of Fit

RSquare	0.098178
RSquare Adj	0.093304
Root Mean Square Error	1.002959
Mean of Response	-0.13123
Observations (or Sum Wgts)	187

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	20.25968	20.2597	20.1403
Error	185	186.09638	1.0059	Prob>F
C Total	186	206.35607		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.493042	0.108991	-4.52	<.0001	-0.708069	-0.278015
YRSCHEM	0.0293465	0.006539	4.49	<.0001	0.0164454	0.0422476

Appendix I

Random sample current job chemical operators (n = 47):
Regression of fluorochemical on gender, years worked in chemical and age; followed by regression equation of fluorochemical on gender and years worked in chemical:

Random Sample
Chemical Operators

ln PFOS ppm
Summary of Fit

RSquare	0.123153
RSquare Adj	0.061978
Root Mean Square Error	0.575509
Mean of Response	0.392725
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	2.000299	0.666766	2.0131
Error	43	14.242071	0.331211	Prob>F
C Total	46	16.242370		0.1263

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	41	13.910223	0.339274	2.0448
Pure Error	2	0.331849	0.165924	Prob>F
Total Error	43	14.242071		0.3833
Max RSq				
0.9796				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0464337	0.412448	0.11	0.9109
GENDER[F-M]	-0.20812	0.102882	-2.02	0.0493
YRSCHEM	0.0092881	0.010914	0.85	0.3995
AGE	0.0029634	0.010819	0.27	0.7855

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	1.3553627	4.0921	0.0493
YRSCHEM	1	1	0.2398607	0.7242	0.3995
AGE	1	1	0.0248502	0.0750	0.7855

Random Sample
Chemical Operators

ln PFOS ppm
Summary of Fit

RSquare	0.121623
RSquare Adj	0.081697
Root Mean Square Error	0.569428
Mean of Response	0.392725
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	1.975448	0.987724	3.0462
Error	44	14.266921	0.324248	Prob>F
C Total	46	16.242370		0.0577

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	26	11.215936	0.431382	2.5450
Pure Error	18	3.050985	0.169499	Prob>F
Total Error	44	14.266921		0.0221
Max RSq				
0.8122				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.152705	0.138482	1.10	0.2762	-0.126387	0.431797
GENDER[F-M]	-0.207949	0.101793	-2.04	0.0471	-0.413098	-0.0028
YRSCHEM	0.0109494	0.008978	1.22	0.2291	-0.007145	0.0290438

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	1.3531877	4.1733	0.0471
YRSCHEM	1	1	0.4822506	1.4873	0.2291

Random Sample
Chemical Operators

ln PFHS ppm
Summary of Fit

RSquare	0.47973
RSquare Adj	0.443432
Root Mean Square Error	0.584505
Mean of Response	-1.17704
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	13.546050	4.51535	13.2165
Error	43	14.690763	0.34165	Prob>F
C Total	46	28.236813		<.0001

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	41	14.362568	0.350307	2.1347
Pure Error	2	0.328195	0.164098	Prob>F
Total Error	43	14.690763		0.3707
Max RSq				
0.9884				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-1.869781	0.418894	-4.46	<.0001
GENDER[F-M]	-0.347847	0.10449	-3.33	0.0018
YRSCHEM	0.047003	0.011085	4.24	0.0001
AGE	-0.000586	0.010988	-0.05	0.9577

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.7861950	11.0822	0.0018
YRSCHEM	1	1	6.1426340	17.9795	0.0001
AGE	1	1	0.0009719	0.0028	0.9577

Random Sample
Chemical Operators

ln PFHS ppm
Summary of Fit

RSquare	0.479696
RSquare Adj	0.456046
Root Mean Square Error	0.577843
Mean of Response	-1.17704
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	13.545078	6.77254	20.2829
Error	44	14.691735	0.33390	Prob>F
C Total	46	28.236813		<.0001

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	26	11.677832	0.449147	2.6825
Pure Error	18	3.013903	0.167439	Prob>F
Total Error	44	14.691735		0.0170
Max RSq				
0.8933				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.890797	0.140529	-13.45	<.0001	-2.174014	-1.60758
GENDER[F-M]	-0.34788	0.103297	-3.37	0.0016	-0.556062	-0.139699
YRSCHEM	0.0466744	0.009111	5.12	<.0001	0.0283126	0.0650363

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.7870700	11.3418	0.0016
YRSCHEM	1	1	8.7629557	26.2440	<.0001

Random Sample
Chemical Operators

ln POAA ppm
Summary of Fit

RSquare	0.197237
RSquare Adj	0.14123
Root Mean Square Error	0.590899
Mean of Response	0.635094
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	3.688886	1.22963	3.5217
Error	43	15.013959	0.34916	Prob>F
C Total	46	18.702845		0.0228

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	41	14.919738	0.363896	7.7243
Pure Error	2	0.094221	0.047111	Prob>F
Total Error	43	15.013959		0.1211
Max RSq				
0.9950				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.3398931	0.423477	0.80	0.4266
GENDER[F-M]	-0.318303	0.105633	-3.01	0.0043
YRSCHEM	0.008909	0.011206	0.80	0.4310
AGE	0.0003393	0.011108	0.03	0.9758

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.1703565	9.0799	0.0043
YRSCHEM	1	1	0.2206817	0.6320	0.4310
AGE	1	1	0.0003258	0.0009	0.9758

Random Sample
Chemical Operators

ln POAA ppm
Summary of Fit

RSquare	0.197219
RSquare Adj	0.160729
Root Mean Square Error	0.584152
Mean of Response	0.635094
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	3.688560	1.84428	5.4047
Error	44	15.014285	0.34123	Prob>F
C Total	46	18.702845		0.0080

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	26	12.692319	0.488166	3.7843
Pure Error	18	2.321965	0.128998	Prob>F
Total Error	44	15.014285		0.0025
Max RSq				
0.8758				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3520616	0.142063	2.48	0.0171	0.0657529	0.6383704
GENDER[F-M]	-0.318283	0.104425	-3.05	0.0039	-0.528737	-0.107829
YRSCHEM	0.0090993	0.00921	0.99	0.3286	-0.009463	0.0276616

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.1700833	9.2901	0.0039
YRSCHEM	1	1	0.3330469	0.9760	0.3286

Random Sample
Chemical Operators

ln PFOSAA ppm
Summary of Fit

RSquare	0.094899
RSquare Adj	0.031753
Root Mean Square Error	1.570558
Mean of Response	-4.4836
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	11.12095	3.70698	1.5028
Error	43	106.06607	2.46665	Prob>F
C Total	46	117.18701		0.2274

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	41	97.82374	2.38594	0.5789
Pure Error	2	8.24233	4.12116	Prob>F
Total Error	43	106.06607		0.8095
Max RSq				
0.9297				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-5.751677	1.125565	-5.11	<.0001
GENDER[F-M]	-0.441575	0.280763	-1.57	0.1231
YRSCHEM	-0.042433	0.029785	-1.42	0.1615
AGE	0.0352765	0.029525	1.19	0.2387

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	6.1015043	2.4736	0.1231
YRSCHEM	1	1	5.0062176	2.0296	0.1615
AGE	1	1	3.5213341	1.4276	0.2387

Random Sample
Chemical Operators

ln PFOSAA ppm
Summary of Fit

RSquare	0.06485
RSquare Adj	0.022343
Root Mean Square Error	1.578171
Mean of Response	-4.4836
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	7.59961	3.79981	1.5256
Error	44	109.58740	2.49062	Prob>F
C Total	46	117.18701		0.2288

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	26	66.99736	2.57682	1.0891
Pure Error	18	42.59004	2.36611	Prob>F
Total Error	44	109.58740		0.4335
Max RSq				
0.6366				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.486637	0.383804	-11.69	<.0001	-5.260141	-3.713133
GENDER[F-M]	-0.439541	0.282119	-1.56	0.1264	-1.008113	0.1290304
YRSCHEM	-0.022657	0.024883	-0.91	0.3675	-0.072806	0.0274916

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	6.0456409	2.4274	0.1264
YRSCHEM	1	1	2.0649335	0.8291	0.3675

Random Sample
Chemical Operators

ln M570ppm
Summary of Fit

RSquare	0.136842
RSquare Adj	0.076621
Root Mean Square Error	1.107108
Mean of Response	-2.03122
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	8.355583	2.78519	2.2724
Error	43	52.704577	1.22569	Prob>F
C Total	46	61.060161		0.0937

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	41	52.472382	1.27981	11.0236
Pure Error	2	0.232195	0.11610	Prob>F
Total Error	43	52.704577		0.0865
Max RSq				
0.9962				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-1.704276	0.793426	-2.15	0.0374
GENDER[F-M]	-0.294632	0.197914	-1.49	0.1439
YRSCHEM	-0.038358	0.020996	-1.83	0.0747
AGE	-0.001758	0.020812	-0.08	0.9331

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	2.7163591	2.2162	0.1439
YRSCHEM	1	1	4.0909545	3.3377	0.0747
AGE	1	1	0.0087486	0.0071	0.9331

Random Sample
Chemical Operators

ln M570 ppm
Summary of Fit

RSquare	0.136699
RSquare Adj	0.097458
Root Mean Square Error	1.094546
Mean of Response	-2.03122
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	8.346835	4.17342	3.4836
Error	44	52.713326	1.19803	Prob>F
C Total	46	61.060161		0.0394

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	26	35.199258	1.35382	1.3914
Pure Error	18	17.514068	0.97300	Prob>F
Total Error	44	52.713326		0.2365
Max RSq				
0.7132				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.767331	0.266189	-6.64	<.0001	-2.303797	-1.230864
GENDER[F-M]	-0.294733	0.195665	-1.51	0.1391	-0.689068	0.0996013
YRSCHEM	-0.039344	0.017258	-2.28	0.0275	-0.074125	-0.004563

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	2.7183290	2.2690	0.1391
YRSCHEM	1	1	6.2266074	5.1974	0.0275

Random Sample
Chemical Operators

ln PFOSA ppm
Summary of Fit

RSquare	0.040282
RSquare Adj	-0.02667
Root Mean Square Error	1.861868
Mean of Response	-3.57167
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	6.25657	2.08552	0.6016
Error	43	149.06169	3.46655	Prob>F
C Total	46	155.31826		0.6175

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	41	145.38604	3.54600	1.9295
Pure Error	2	3.67565	1.83782	Prob>F
Total Error	43	149.06169		0.4006
Max RSq				
0.9763				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-2.698905	1.334337	-2.02	0.0494
GENDER[F-M]	-0.197181	0.33284	-0.59	0.5567
YRSCHEM	-0.023905	0.03531	-0.68	0.5020
AGE	-0.01721	0.035001	-0.49	0.6254

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	1.2166245	0.3510	0.5567
YRSCHEM	1	1	1.5888669	0.4583	0.5020
AGE	1	1	0.8381204	0.2418	0.6254

Random Sample
Chemical Operators

ln PFOSA ppm
Summary of Fit

RSquare	0.034886
RSquare Adj	-0.00898
Root Mean Square Error	1.845756
Mean of Response	-3.57167
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	5.41845	2.70923	0.7952
Error	44	149.89981	3.40681	Prob>F
C Total	46	155.31826		0.4579

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	26	82.89148	3.18813	0.8564
Pure Error	18	67.00833	3.72268	Prob>F
Total Error	44	149.89981		0.6485
Max RSq				
0.5686				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.316074	0.44888	-7.39	<.0001	-4.220728	-2.411419
GENDER[F-M]	-0.198173	0.329953	-0.60	0.5512	-0.863148	0.4668018
YRSCHEM	-0.033553	0.029102	-1.15	0.2552	-0.092205	0.0250987

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	1.2289470	0.3607	0.5512
YRSCHEM	1	1	4.5285163	1.3293	0.2552

Random Sample
Chemical Operators

ln M556 ppm
Summary of Fit

RSquare	0.127024
RSquare Adj	0.066119
Root Mean Square Error	1.108876
Mean of Response	-3.12253
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	7.693385	2.56446	2.0856
Error	43	52.873065	1.22961	Prob>F
C Total	46	60.566451		0.1162

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	41	52.710027	1.28561	15.7707
Pure Error	2	0.163038	0.08152	Prob>F
Total Error	43	52.873065		0.0613
Max RSq				
0.9973				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-2.787872	0.794694	-3.51	0.0011
GENDER[F-M]	-0.340998	0.19823	-1.72	0.0926
YRSCHEM	-0.03131	0.02103	-1.49	0.1438
AGE	-0.004424	0.020846	-0.21	0.8329

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.6385764	2.9591	0.0926
YRSCHEM	1	1	2.7256630	2.2167	0.1438
AGE	1	1	0.0553796	0.0450	0.8329

Random Sample
Chemical Operators

ln M556 ppm
Summary of Fit

RSquare	0.12611
RSquare Adj	0.086387
Root Mean Square Error	1.096777
Mean of Response	-3.12253
Observations (or Sum Wgts)	47

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	7.638006	3.81900	3.1748
Error	44	52.928445	1.20292	Prob>F
C Total	46	60.566451		0.0515

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	26	36.751620	1.41352	1.5728
Pure Error	18	16.176825	0.89871	Prob>F
Total Error	44	52.928445		0.1616
Max RSq				
0.7329				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.946517	0.266731	-11.05	<.0001	-3.484077	-2.408957
GENDER[F-M]	-0.341253	0.196063	-1.74	0.0888	-0.736392	0.0538852
YRSCHEM	-0.03379	0.017293	-1.95	0.0571	-0.068642	0.0010617

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.6441565	3.0294	0.0888
YRSCHEM	1	1	4.5927300	3.8180	0.0571

Appendix J

Random sample current job engineer/lab group (n = 23):
Regression of fluorochemical on gender, years worked in chemical and age; followed by regression equation of fluorochemical on gender and years worked in chemical:

Random Sample
Engineer/Lab

ln PFOS ppm
Summary of Fit

RSquare	0.391004
RSquare Adj	0.294847
Root Mean Square Error	0.867828
Mean of Response	-0.93898
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	9.187310	3.06244	4.0663
Error	19	14.309381	0.75313	Prob>F
C Total	22	23.496691		0.0217

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	18	13.862763	0.770154	1.7244
Pure Error	1	0.446618	0.446618	Prob>F
Total Error	19	14.309381		0.5438
Max RSq				
0.9810				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-0.616826	1.435087	-0.43	0.6722	-3.620476	2.3868238
GENDER[F-M]	-0.561666	0.214754	-2.62	0.0170	-1.011148	-0.112185
YRSCHEM	0.0467532	0.038427	1.22	0.2386	-0.033675	0.1271809
AGE	-0.031175	0.047633	-0.65	0.5206	-0.130872	0.0685214

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	5.1516007	6.8403	0.0170
YRSCHEM	1	1	1.1148580	1.4803	0.2386
AGE	1	1	0.3226016	0.4284	0.5206

Random Sample
Engineer/Lab

ln PFOS ppm
Summary of Fit

RSquare	0.37727:
RSquare Adj	0.31500:
Root Mean Square Error	0.85533(
Mean of Response	-0.9389ξ
Observations (or Sum Wgts)	2:

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	8.864708	4.43235	6.0584
Error	20	14.631983	0.73160	Prob>F
C Total	22	23.496691		0.0088

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	12	10.913717	0.909476	1.9568
Pure Error	8	3.718265	0.464783	Prob>F
Total Error	20	14.631983		0.1735
Max RSq				
0.8418				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.538619	0.271378	-5.67	<.0001	-2.104699	-0.972539
GENDER[F-M]	-0.537774	0.208582	-2.58	0.0180	-0.972865	-0.102683
YRSCHEM	0.0233371	0.013818	1.69	0.1068	-0.005487	0.0521614

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	4.8631688	6.6473	0.0180
YRSCHEM	1	1	2.0866755	2.8522	0.1068

Random Sample
Engineer/Lab

ln PFHS ppm
Summary of Fit

RSquare	0.427513
RSquare Adj	0.33712
Root Mean Square Error	1.074255
Mean of Response	-2.54721
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	16.373916	5.45797	4.7295
Error	19	21.926470	1.15402	Prob>F
C Total	22	38.300386		0.0125

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	18	21.348414	1.18602	2.0517
Pure Error	1	0.578056	0.57806	Prob>F
Total Error	19	21.926470		0.5060
Max RSq				
0.9849				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.462716	1.776447	-1.39	0.1817	-6.180835	1.2554025
GENDER[F-M]	-0.741805	0.265837	-2.79	0.0117	-1.298203	-0.185407
YRSCHEM	0.0546509	0.047567	1.15	0.2648	-0.044908	0.1542097
AGE	-0.030306	0.058963	-0.51	0.6132	-0.153717	0.0931054

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	8.9859716	7.7866	0.0117
YRSCHEM	1	1	1.5233215	1.3200	0.2648
AGE	1	1	0.3048564	0.2642	0.6132

Random Sample
Engineer/Lab

ln PFHS ppm
Summary of Fit

RSquare	0.419553
RSquare Adj	0.361509
Root Mean Square Error	1.054308
Mean of Response	-2.54721
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	16.069059	8.03453	7.2281
Error	20	22.231326	1.11157	Prob>F
C Total	22	38.300386		0.0043

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	12	18.182976	1.51525	2.9943
Pure Error	8	4.048350	0.50604	Prob>F
Total Error	20	22.231326		0.0638
Max RSq				
0.8943				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.358798	0.334507	-10.04	<.0001	-4.056563	-2.661034
GENDER[F-M]	-0.718579	0.257103	-2.79	0.0112	-1.254884	-0.182275
YRSCHEM	0.0318879	0.017033	1.87	0.0759	-0.003642	0.0674175

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	8.6829819	7.8115	0.0112
YRSCHEM	1	1	3.8959557	3.5049	0.0759

Random Sample
Engineer/Lab

ln POAAppm
Summary of Fit

RSquare	0.328411
RSquare Adj	0.222371
Root Mean Square Error	0.953194
Mean of Response	-1.56794
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	8.441730	2.81391	3.0970
Error	19	17.263008	0.90858	Prob>F
C Total	22	25.704738		0.0514

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	18	15.855759	0.88088	0.6260
Pure Error	1	1.407248	1.40725	Prob>F
Total Error	19	17.263008		0.7776
Max RSq				
0.9453				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.020183	1.576253	-0.65	0.5252	-4.319296	2.2789291
GENDER[F-M]	-0.663796	0.235879	-2.81	0.0111	-1.157492	-0.170099
YRSCHEM	0.0323327	0.042207	0.77	0.4531	-0.056007	0.1206719
AGE	-0.03271	0.052319	-0.63	0.5393	-0.142213	0.0767938

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	7.1953870	7.9194	0.0111
YRSCHEM	1	1	0.5331884	0.5868	0.4531
AGE	1	1	0.3551409	0.3909	0.5393

Random Sample
Engineer/Lab

ln POAA ppm

Summary of Fit

RSquare	0.31459
RSquare Adj	0.24605
Root Mean Square Error	0.93856
Mean of Response	-1.5679
Observations (or Sum Wgts)	2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	8.086590	4.04329	4.5899
Error	20	17.618149	0.88091	Prob>F
C Total	22	25.704738		0.0229

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	12	15.005915	1.25049	3.8297
Pure Error	8	2.612233	0.32653	Prob>F
Total Error	20	17.618149		0.0326
Max RSq				
0.8984				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.987348	0.297785	-6.67	<.0001	-2.608513	-1.366184
GENDER[F-M]	-0.638727	0.228879	-2.79	0.0113	-1.116156	-0.161298
YRSCHEM	0.007764	0.015163	0.51	0.6142	-0.023865	0.0393931

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	6.8604184	7.7879	0.0113
YRSCHEM	1	1	0.2309580	0.2622	0.6142

Random Sample
Engineer/Lab

ln PFOSAA ppm
Summary of Fit

RSquare	0.269018
RSquare Adj	0.1536
Root Mean Square Error	1.302561
Mean of Response	-5.2038
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	11.863793	3.95460	2.3308
Error	19	32.236613	1.69666	Prob>F
C Total	22	44.100406		0.1067

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	18	32.222887	1.79016	130.4211
Pure Error	1	0.013726	0.01373	Prob>F
Total Error	19	32.236613		0.0688
Max RSq				
0.9997				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.142278	2.153984	-0.99	0.3324	-6.650586	2.3660301
GENDER[F-M]	-0.770545	0.322333	-2.39	0.0273	-1.445192	-0.095899
YRSCHEM	0.0668187	0.057677	1.16	0.2610	-0.053899	0.1875362
AGE	-0.107688	0.071495	-1.51	0.1484	-0.257327	0.0419505

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	9.6957614	5.7146	0.0273
YRSCHEM	1	1	2.2771575	1.3421	0.2610
AGE	1	1	3.8493437	2.2688	0.1484

Random Sample
Engineer/Lab

ln PFOSAA ppm
Summary of Fit

RSquare	0.181732
RSquare Adj	0.099905
Root Mean Square Error	1.343242
Mean of Response	-5.20338
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	8.014449	4.00722	2.2209
Error	20	36.085957	1.80430	Prob>F
C Total	22	44.100406		0.1346

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	12	15.048236	1.25402	0.4769
Pure Error	8	21.037721	2.62972	Prob>F
Total Error	20	36.085957		0.8805
Max RSq				
0.5230				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.326428	0.426179	-12.50	<.0001	-6.215415	-4.437441
GENDER[F-M]	-0.688015	0.327563	-2.10	0.0486	-1.371293	-0.004736
YRSCHEM	-0.014068	0.021701	-0.65	0.5242	-0.059334	0.0311988

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	7.9600380	4.4117	0.0486
YRSCHEM	1	1	0.7582318	0.4202	0.5242

Random Sample
Engineer/Lab

ln M570 ppm
Summary of Fit

RSquare	0.04274
RSquare Adj	-0.10841
Root Mean Square Error	0.942783
Mean of Response	-3.01612
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0.754025	0.251342	0.2828
Error	19	16.887940	0.888839	Prob>F
C Total	22	17.641966		0.8372

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	18	16.791797	0.932878	9.7030
Pure Error	1	0.096143	0.096143	Prob>F
Total Error	19	16.887940		0.2481
Max RSq				
0.9946				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.114124	1.559036	-1.36	0.1910	-5.3772	1.1489527
GENDER[F-M]	-0.170074	0.233302	-0.73	0.4749	-0.658377	0.3182297
YRSCHEM	0.0257524	0.041746	0.62	0.5446	-0.061622	0.1131268
AGE	-0.033236	0.051747	-0.64	0.5284	-0.141543	0.0750714

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.47234628	0.5314	0.4749
YRSCHEM	1	1	0.33824664	0.3805	0.5446
AGE	1	1	0.36666114	0.4125	0.5284

Random Sample
Engineer/Lab

ln M570ppm

Summary of Fit

RSquare	0.021957
RSquare Adj	-0.07585
Root Mean Square Error	0.928833
Mean of Response	-3.01612
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.387364	0.193682	0.2245
Error	20	17.254602	0.862730	Prob>F
C Total	22	17.641966		0.8009

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	12	8.184523	0.68204	0.6016
Pure Error	8	9.070079	1.13376	Prob>F
Total Error	20	17.254602		0.7939
Max RSq				
0.4859				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.09685	0.294697	-10.51	<.0001	-3.711572	-2.482128
GENDER[F-M]	-0.144602	0.226505	-0.64	0.5305	-0.61708	0.3278751
YRSCHEM	0.0007884	0.015006	0.05	0.9586	-0.030513	0.0320895

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.35161749	0.4076	0.5305
YRSCHEM	1	1	0.00238175	0.0028	0.9586

Random Sample
Engineer/Lab

ln PFOSA ppm
Summary of Fit

RSquare	0.0115-
RSquare Adj	-0.1445:
Root Mean Square Error	1.9530:
Mean of Response	-5.3932:
Observations (or Sum Wgts)	2:

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0.846121	0.28204	0.0739
Error	19	72.471423	3.81429	Prob>F
C Total	22	73.317544		0.9732

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	18	72.104070	4.00578	10.9044
Pure Error	1	0.367353	0.36735	Prob>F
Total Error	19	72.471423		0.2345
Max RSq				
0.9950				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.985167	3.229618	-1.85	0.0794	-12.74479	0.7744532
GENDER[F-M]	0.1760337	0.483297	0.36	0.7197	-0.835511	1.1875781
YRSCHEM	-0.001762	0.086478	-0.02	0.9840	-0.182762	0.1792383
AGE	0.0171392	0.107197	0.16	0.8747	-0.207225	0.2415031

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.50603123	0.1327	0.7197
YRSCHEM	1	1	0.00158323	0.0004	0.9840
AGE	1	1	0.09750555	0.0256	0.8747

Random Sample
Engineer/Lab

ln PFOSA ppm
Summary of Fit

RSquare	0.01021
RSquare Adj	-0.0887
Root Mean Square Error	1.90484
Mean of Response	-5.3932
Observations (or Sum Wgts)	2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.748615	0.37431	0.1032
Error	20	72.568929	3.62845	Prob>F
C Total	22	73.317544		0.9025

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	12	60.697300	5.05811	3.4085
Pure Error	8	11.871629	1.48395	Prob>F
Total Error	20	72.568929		0.0452
Max RSq				
0.8381				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.478392	0.604364	-9.06	<.0001	-6.739063	-4.217722
GENDER[F-M]	0.1628986	0.464516	0.35	0.7295	-0.806057	1.1318545
YRSCHEM	0.0111116	0.030774	0.36	0.7218	-0.053081	0.0753039

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.44622510	0.1230	0.7295
YRSCHEM	1	1	0.47306076	0.1304	0.7218

Random Sample
Engineer/Lab

ln M556 ppm
Summary of Fit

RSquare	0.03967
RSquare Adj	-0.1119
Root Mean Square Error	1.21823
Mean of Response	-4.6503
Observations (or Sum Wgts)	2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	1.164918	0.38831	0.2616
Error	19	28.197906	1.48410	Prob>F
C Total	22	29.362824		0.8521

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	18	28.172151	1.56512	60.7697
Pure Error	1	0.025755	0.02575	Prob>F
Total Error	19	28.197906		0.1006
Max RSq				
0.9991				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.844133	2.014541	-2.90	0.0092	-10.06059	-1.627679
GENDER[F-M]	-0.126807	0.301466	-0.42	0.6787	-0.757779	0.5041648
YRSCHEM	-0.018287	0.053943	-0.34	0.7383	-0.13119	0.0946156
AGE	0.0342181	0.066866	0.51	0.6147	-0.105734	0.1741698

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.26258648	0.1769	0.6787
YRSCHEM	1	1	0.17056194	0.1149	0.7383
AGE	1	1	0.38865284	0.2619	0.6147

Random Sample
Engineer/Lab

In M556 ppm
Summary of Fit

RSquare	0.026437
RSquare Adj	-0.07092
Root Mean Square Error	1.195545
Mean of Response	-4.65037
Observations (or Sum Wgts)	23

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.776265	0.38813	0.2715
Error	20	28.586559	1.42933	Prob>F
C Total	22	29.362824		0.7650

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	12	13.466606	1.12222	0.5938
Pure Error	8	15.119953	1.88999	Prob>F
Total Error	20	28.586559		0.7996
Max RSq				
0.4851				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.832364	0.379318	-12.74	<.0001	-5.623603	-4.041126
GENDER[F-M]	-0.153031	0.291545	-0.52	0.6054	-0.76118	0.4551172
YRSCHEM	0.0074147	0.019315	0.38	0.7051	-0.032874	0.0477039

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.39380354	0.2755	0.6054
YRSCHEM	1	1	0.21064617	0.1474	0.7051

Appendix K

All participant current job chemical operators (n = 64):
Regression of fluorochemical on gender, years worked in chemical and age; followed by regression equation of fluorochemical on gender and years worked in chemical

All Participants
Chemical Operators

ln PFOS ppm
Summary of Fit

RSquare	0.150439
RSquare Adj	0.107961
Root Mean Square Error	0.643599
Mean of Response	0.392284
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	4.400964	1.46699	3.5416
Error	60	24.853181	0.41422	Prob>F
C Total	63	29.254145		0.0198

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	23.861535	0.418623	1.2664
Pure Error	3	0.991647	0.330549	Prob>F
Total Error	60	24.853181		0.4953
Max RSq				
0.9661				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.062633	0.401961	0.16	0.8767	-0.741408	0.8666743
GENDER[F-M]	-0.250464	0.10427	-2.40	0.0194	-0.459035	-0.041893
YRSCHEM	0.0171146	0.011052	1.55	0.1267	-0.004992	0.0392214
AGE	-0.000079	0.010698	-0.01	0.9941	-0.021478	0.0213193

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	2.3900299	5.7700	0.0194
YRSCHEM	1	1	0.9933570	2.3981	0.1267
AGE	1	1	0.0000227	0.0001	0.9941

All Participants
Chemical Operators

ln PFOSdfppm
Summary of Fit

RSquare	0.150438
RSquare Adj	0.122584
Root Mean Square Error	0.638302
Mean of Response	0.392284
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	4.400941	2.20047	5.4009
Error	61	24.853204	0.40743	Prob>F
C Total	63	29.254145		0.0069

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	31	15.838180	0.510909	1.7002
Pure Error	30	9.015024	0.300501	Prob>F
Total Error	61	24.853204		0.0748
Max RSq				
0.6918				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0598248	0.132618	0.45	0.6535	-0.205362	0.325012
GENDER[F-M]	-0.250543	0.10288	-2.44	0.0178	-0.456265	-0.04482
YRSCHEM	0.017067	0.008912	1.92	0.0602	-0.000753	0.0348868

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	2.4162931	5.9306	0.0178
YRSCHEM	1	1	1.4943613	3.6678	0.0602

All Participants
Chemical Operators

ln PFHS ppm
Summary of Fit

RSquare	0.415491
RSquare Adj	0.386266
Root Mean Square Error	0.644165
Mean of Response	-1.23054
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	17.697687	5.89923	14.2168
Error	60	24.896914	0.41495	Prob>F
C Total	63	42.594602		<.0001

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	24.223557	0.424975	1.8934
Pure Error	3	0.673357	0.224452	Prob>F
Total Error	60	24.896914		0.3353
Max RSq				
0.9842				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.721892	0.402314	-4.28	<.0001	-2.52664	-0.917144
GENDER[F-M]	-0.370838	0.104362	-3.55	0.0007	-0.579593	-0.162083
YRSCHEM	0.0480263	0.011061	4.34	<.0001	0.0259001	0.0701525
AGE	-0.005737	0.010707	-0.54	0.5940	-0.027155	0.01568

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	5.2393846	12.6266	0.0007
YRSCHEM	1	1	7.8221792	18.8510	<.0001
AGE	1	1	0.1191450	0.2871	0.5940

All Participants
Chemical Operators

ln PFHS ppm
Summary of Fit

RSquare	0.412694
RSquare Adj	0.393438
Root Mean Square Error	0.64039
Mean of Response	-1.23054
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	17.578542	8.78927	21.4321
Error	61	25.016059	0.41010	Prob>F
C Total	63	42.594602		<.0001

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	31	16.785999	0.541484	1.9738
Pure Error	30	8.230060	0.274335	Prob>F
Total Error	61	25.016059		0.0329
Max RSq				
0.8068				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.925193	0.133052	-14.47	<.0001	-2.191247	-1.659138
GENDER[F-M]	-0.3765	0.103217	-3.65	0.0005	-0.582895	-0.170105
YRSCHEM	0.0445754	0.008941	4.99	<.0001	0.0266973	0.0624535

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	5.456536	13.3054	0.0005
YRSCHEM	1	1	10.193737	24.8568	<.0001

All Participants
Chemical Operators

ln POAA ppm
Summary of Fit

RSquare	0.21249
RSquare Adj	0.173115
Root Mean Square Error	0.567525
Mean of Response	0.614523
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	5.214396	1.73813	5.3965
Error	60	19.325057	0.32208	Prob>F
C Total	63	24.539453		0.0024

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	18.851100	0.330721	2.0934
Pure Error	3	0.473957	0.157986	Prob>F
Total Error	60	19.325057		0.3009
Max RSq				
0.9807				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.4370637	0.354448	1.23	0.2224	-0.271939	1.1460661
GENDER[F-M]	-0.313225	0.091945	-3.41	0.0012	-0.497143	-0.129307
YRSCHEM	0.0150521	0.009745	1.54	0.1277	-0.004442	0.0345458
AGE	-0.004228	0.009433	-0.45	0.6556	-0.023097	0.0146413

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.7378707	11.6053	0.0012
YRSCHEM	1	1	0.7683549	2.3856	0.1277
AGE	1	1	0.0647015	0.2009	0.6556

All Participants
Chemical Operators

ln POAA ppm
Summary of Fit

RSquare	0.209854
RSquare Adj	0.183947
Root Mean Square Error	0.563795
Mean of Response	0.614523
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	5.149695	2.57485	8.1004
Error	61	19.389758	0.31786	Prob>F
C Total	63	24.539453		0.0008

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	31	14.849379	0.479012	3.1650
Pure Error	30	4.540380	0.151346	Prob>F
Total Error	61	19.389758		0.0011
Max RSq				
0.8150				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.2872479	0.117138	2.45	0.0171	0.0530152	0.5214806
GENDER[F-M]	-0.317397	0.090872	-3.49	0.0009	-0.499106	-0.135688
YRSCHEM	0.0125091	0.007871	1.59	0.1172	-0.003231	0.0282488

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	3.8778718	12.1997	0.0009
YRSCHEM	1	1	0.8027714	2.5255	0.1172

All Participants
Chemical Operators

ln PFOSAA ppm
Summary of Fit

RSquare	0.088735
RSquare Adj	0.043172
Root Mean Square Error	1.583933
Mean of Response	-4.28694
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	14.65802	4.88601	1.9475
Error	60	150.53065	2.50884	Prob>F
C Total	63	165.18867		0.1316

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	134.42483	2.35833	0.4393
Pure Error	3	16.10582	5.36861	Prob>F
Total Error	60	150.53065		0.9106
Max RSq				
0.9025				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.252813	0.989248	-5.31	<.0001	-7.231604	-3.274023
GENDER[F-M]	-0.52127	0.256614	-2.03	0.0467	-1.034575	-0.007964
YRSCHEM	-0.04353	0.027199	-1.60	0.1148	-0.097936	0.0108755
AGE	0.0265422	0.026328	1.01	0.3174	-0.026121	0.0792053

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	10.352296	4.1263	0.0467
YRSCHEM	1	1	6.426227	2.5614	0.1148
AGE	1	1	2.549914	1.0164	0.3174

All Participants
Chemical Operators

ln PFOSAA ppm
Summary of Fit

RSquare	0.073299
RSquare Adj	0.042915
Root Mean Square Error	1.584146
Mean of Response	-4.28694
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	12.10810	6.05405	2.4124
Error	61	153.08056	2.50952	Prob>F
C Total	63	165.18867		0.0981

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	31	84.66080	2.73099	1.1975
Pure Error	30	68.41976	2.28066	Prob>F
Total Error	61	153.08056		0.3117
Max RSq				
0.5858				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.312304	0.329134	-13.10	<.0001	-4.970449	-3.654159
GENDER[F-M]	-0.495076	0.25533	-1.94	0.0571	-1.00564	0.0154881
YRSCHEM	-0.027566	0.022117	-1.25	0.2174	-0.071792	0.0166594

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	9.4347501	3.7596	0.0571
YRSCHEM	1	1	3.8984466	1.5535	0.2174

All Participants
Chemical Operators

ln M570 ppm
Summary of Fit

RSquare	0.164237
RSquare Adj	0.122449
Root Mean Square Error	1.12124
Mean of Response	-1.94564
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	14.823015	4.94100	3.9302
Error	60	75.430695	1.25718	Prob>F
C Total	63	90.253710		0.0126

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	75.084356	1.31727	11.4102
Pure Error	3	0.346339	0.11545	Prob>F
Total Error	60	75.430695		0.0335
Max RSq				
0.9962				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.222446	0.700272	-1.75	0.0860	-2.623199	0.1783065
GENDER[F-M]	-0.330479	0.181653	-1.82	0.0739	-0.693839	0.0328812
YRSCHEM	-0.038776	0.019254	-2.01	0.0485	-0.077289	-0.000263
AGE	-0.012926	0.018637	-0.69	0.4906	-0.050205	0.0243533

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	4.1610173	3.3098	0.0739
YRSCHEM	1	1	5.0990709	4.0560	0.0485
AGE	1	1	0.6047597	0.4810	0.4906

All Participants
Chemical Operators

ln M570 ppm
Summary of Fit

RSquare	0.157537
RSquare Adj	0.129915
Root Mean Square Error	1.11646
Mean of Response	-1.94564
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	14.218255	7.10913	5.7033
Error	61	76.035455	1.24648	Prob>F
C Total	63	90.253710		0.0054

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	31	38.667300	1.24733	1.0014
Pure Error	30	37.368155	1.24561	Prob>F
Total Error	61	76.035455		0.4993
Max RSq				
0.5860				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.680474	0.231964	-7.24	<.0001	-2.144315	-1.216632
GENDER[F-M]	-0.343235	0.179949	-1.91	0.0612	-0.703066	0.0165953
YRSCHEM	-0.04655	0.015587	-2.99	0.0041	-0.077719	-0.015382

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	4.534934	3.6382	0.0612
YRSCHEM	1	1	11.117067	8.9187	0.0041

All Participants
Chemical Operators

ln PFOSA ppm
Summary of Fit

RSquare	0.036452
RSquare Adj	-0.01173
Root Mean Square Error	1.87564
Mean of Response	-3.8617
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	7.98536	2.66179	0.7566
Error	60	211.08153	3.51803	Prob>F
C Total	63	219.06689		0.5229

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	207.20231	3.63513	2.8112
Pure Error	3	3.87923	1.29308	Prob>F
Total Error	60	211.08153		0.2148
Max RSq				
0.9823				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.083552	1.171434	-2.63	0.0108	-5.426769	-0.740335
GENDER[F-M]	-0.119692	0.303874	-0.39	0.6951	-0.727531	0.4881469
YRSCHEM	-0.028921	0.032208	-0.90	0.3728	-0.093347	0.0355046
AGE	-0.01353	0.031176	-0.43	0.6659	-0.075892	0.0488322

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.5458097	0.1551	0.6951
YRSCHEM	1	1	2.8366160	0.8063	0.3728
AGE	1	1	0.6625603	0.1883	0.6659

All Participants
Chemical Operators

ln PFOSA ppm
Summary of Fit

RSquare	0.036452
RSquare Adj	-0.01173
Root Mean Square Error	1.87564
Mean of Response	-3.8617
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	7.98536	2.66179	0.7566
Error	60	211.08153	3.51803	Prob>F
C Total	63	219.06689		0.5229

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	207.20231	3.63513	2.8112
Pure Error	3	3.87923	1.29308	Prob>F
Total Error	60	211.08153		0.2148
Max RSq				
0.9823				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.083552	1.171434	-2.63	0.0108	-5.426769	-0.740335
GENDER[F-M]	-0.119692	0.303874	-0.39	0.6951	-0.727531	0.4881469
YRSCHEM	-0.028921	0.032208	-0.90	0.3728	-0.093347	0.0355046
AGE	-0.01353	0.031176	-0.43	0.6659	-0.075892	0.0488322

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.5458097	0.1551	0.6951
YRSCHEM	1	1	2.8366160	0.8063	0.3728
AGE	1	1	0.6625603	0.1883	0.6659

All Participants
Chemical Operators

ln PFOSA ppm
Summary of Fit

RSquare	0.033427
RSquare Adj	0.001736
Root Mean Square Error	1.86312
Mean of Response	-3.8617
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	7.32280	3.66140	1.0548
Error	61	211.74409	3.47121	Prob>F
C Total	63	219.06689		0.3545

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	31	107.46461	3.46660	0.9973
Pure Error	30	104.27948	3.47598	Prob>F
Total Error	61	211.74409		0.5037
Max RSq				
0.5240				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.562968	0.387096	-9.20	<.0001	-4.337015	-2.788922
GENDER[F-M]	-0.133044	0.300294	-0.44	0.6593	-0.73352	0.4674322
YRSCHEM	-0.037059	0.026012	-1.42	0.1593	-0.089073	0.0149549

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.6813608	0.1963	0.6593
YRSCHEM	1	1	7.0457385	2.0298	0.1593

All Participants
Chemical Operators

ln M556 ppm
Summary of Fit

RSquare	0.135522
RSquare Adj	0.092298
Root Mean Square Error	1.04555
Mean of Response	-3.10248
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	10.282420	3.42747	3.1353
Error	60	65.590476	1.09317	Prob>F
C Total	63	75.872896		0.0319

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	57	65.396881	1.14731	17.7790
Pure Error	3	0.193596	0.06453	Prob>F
Total Error	60	65.590476		0.0177
Max RSq				
0.9974				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.765873	0.653	-4.24	<.0001	-4.072068	-1.459679
GENDER[F-M]	-0.36628	0.16939	-2.16	0.0346	-0.705111	-0.027448
YRSCHEM	-0.03039	0.017954	-1.69	0.0957	-0.066304	0.005523
AGE	-0.006153	0.017379	-0.35	0.7245	-0.040916	0.0286099

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	5.1113761	4.6757	0.0346
YRSCHEM	1	1	3.1321284	2.8652	0.0957
AGE	1	1	0.1370284	0.1253	0.7245

All Participants
Chemical Operators

ln M556 ppm
Summary of Fit

RSquare	0.133716
RSquare Adj	0.105313
Root Mean Square Error	1.038027
Mean of Response	-3.10248
Observations (or Sum Wgts)	64

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	10.145391	5.07270	4.7078
Error	61	65.727505	1.07750	Prob>F
C Total	63	75.872896		0.0126

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	31	36.884521	1.18982	1.2376
Pure Error	30	28.842984	0.96143	Prob>F
Total Error	61	65.727505		0.2807
Max RSq				
0.6199				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.983898	0.215668	-13.84	<.0001	-3.415154	-2.552642
GENDER[F-M]	-0.372352	0.167307	-2.23	0.0298	-0.706904	-0.0378
YRSCHEM	-0.034091	0.014492	-2.35	0.0219	-0.06307	-0.005112

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	5.3369633	4.9531	0.0298
YRSCHEM	1	1	5.9624437	5.5336	0.0219

Appendix L

All participant current job engineer/lab group ($n = 37$):
Regression equation of fluorochemical on gender, years worked in chemical and age; followed by regression equation of fluorochemical on gender and years worked in chemical

All Participants
Engineer/Lab

ln PFOS ppm
Summary of Fit

RSquare	0.386611
RSquare Adj	0.330848
Root Mean Square Error	0.825205
Mean of Response	-0.94033
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	14.163658	4.72122	6.9332
Error	33	22.471780	0.68096	Prob>F
C Total	36	36.635438		0.0010

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	32	22.025162	0.688286	1.5411
Pure Error	1	0.446618	0.446618	Prob>F
Total Error	33	22.471780		0.5735
Max RSq				
0.9878				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.071342	0.85018	-2.44	0.0204	-3.801035	-0.341649
GENDER[F-M]	-0.434286	0.165902	-2.62	0.0133	-0.771815	-0.096757
YRSCHEM	0.0189436	0.021692	0.87	0.3888	-0.025188	0.0630753
AGE	0.0146474	0.026443	0.55	0.5834	-0.039152	0.0684465

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	4.6662679	6.8525	0.0133
YRSCHEM	1	1	0.5193576	0.7627	0.3888
AGE	1	1	0.2089349	0.3068	0.5834

All Participants
Engineer/Lab

ln PFOS ppm
Summary of Fit

RSquare	0.380908
RSquare Adj	0.344491
Root Mean Square Error	0.81675
Mean of Response	-0.94033
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	13.954723	6.97736	10.4596
Error	34	22.680715	0.66708	Prob>F
C Total	36	36.635438		0.0003

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	19	12.658602	0.666242	0.9972
Pure Error	15	10.022112	0.668141	Prob>F
Total Error	34	22.680715		0.5100
Max RSq				
0.7264				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.615211	0.20928	-7.72	<.0001	-2.040516	-1.189906
GENDER[F-M]	-0.439047	0.163982	-2.68	0.0113	-0.772296	-0.105797
YRSCHEM	0.0293537	0.010721	2.74	0.0098	0.0075663	0.051141

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	4.7819718	7.1685	0.0113
YRSCHEM	1	1	5.0008180	7.4966	0.0098

All Participants
Engineer/Lab

ln PFHS ppm
Summary of Fit

RSquare	0.445073
RSquare Adj	0.394625
Root Mean Square Error	0.963293
Mean of Response	-2.5975
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	24.559883	8.18663	8.8224
Error	33	30.621774	0.92793	Prob>F
C Total	36	55.181656		0.0002

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	32	30.043718	0.938866	1.6242
Pure Error	1	0.578056	0.578056	Prob>F
Total Error	33	30.621774		0.5616
Max RSq				
0.9895				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.078592	0.992447	-4.11	0.0002	-6.097727	-2.059457
GENDER[F-M]	-0.566055	0.193664	-2.92	0.0062	-0.960065	-0.172045
YRSCHEM	0.0256075	0.025321	1.01	0.3192	-0.025909	0.077124
AGE	0.0189228	0.030868	0.61	0.5441	-0.043879	0.0817245

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	7.9274937	8.5432	0.0062
YRSCHEM	1	1	0.9490174	1.0227	0.3192
AGE	1	1	0.3487090	0.3758	0.5441

All Participants
Engineer/Lab

ln PFHS ppm

Summary of Fit

RSquare	0.438754
RSquare Adj	0.405774
Root Mean Square Error	0.954409
Mean of Response	-2.5975
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	24.211174	12.1056	13.2897
Error	34	30.970483	0.9109	Prob>F
C Total	36	55.181656		<.0001

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	19	22.898600	1.20519	2.2396
Pure Error	15	8.071882	0.53813	Prob>F
Total Error	34	30.970483		0.0591
Max RSq				
0.8537				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.48932	0.244553	-14.27	<.0001	-3.986308	-2.992332
GENDER[F-M]	-0.572206	0.19162	-2.99	0.0052	-0.961623	-0.182789
YRSCHEM	0.0390561	0.012528	3.12	0.0037	0.0135966	0.0645156

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	8.1225045	8.9170	0.0052
YRSCHEM	1	1	8.8530880	9.7191	0.0037

All Participants
Engineer/Lab

In POAA ppm
Summary of Fit

RSquare	0.305199
RSquare Adj	0.242035
Root Mean Square Error	0.910104
Mean of Response	-1.621[illegible]2
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	12.006567	4.00219	4.8319
Error	33	27.333536	0.82829	Prob>F
C Total	36	39.340103		0.0068

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	32	25.926287	0.81020	0.5757
Pure Error	1	1.407248	1.40725	Prob>F
Total Error	33	27.333536		0.8031
Max RSq				
0.9642				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.930493	0.937648	-3.13	0.0037	-4.838141	-1.022846
GENDER[F-M]	-0.527939	0.182971	-2.89	0.0068	-0.900194	-0.155684
YRSCHEM	-0.002986	0.023923	-0.12	0.9014	-0.051658	0.0456859
AGE	0.0256936	0.029164	0.88	0.3847	-0.03364	0.0850277

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	6.8958131	8.3254	0.0068
YRSCHEM	1	1	0.0129048	0.0156	0.9014
AGE	1	1	0.6428967	0.7762	0.3847

All Participants
Engineer/Lab

ln POAA ppm

Summary of Fit

RSquare	0.288857
RSquare Adj	0.247025
Root Mean Square Error	0.907103
Mean of Response	-1.62112
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	11.363671	5.68184	6.9052
Error	34	27.976432	0.82284	Prob>F
C Total	36	39.340103		0.0030

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	19	17.231908	0.906943	1.2661
Pure Error	15	10.744524	0.716302	Prob>F
Total Error	34	27.976432		0.3249
Max RSq				
0.7269				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.130374	0.232431	-9.17	<.0001	-2.602729	-1.65802
GENDER[F-M]	-0.53629	0.182123	-2.94	0.0058	-0.906406	-0.166175
YRSCHEM	0.0152746	0.011907	1.28	0.2082	-0.008923	0.0394721

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	7.1348529	8.6710	0.0058
YRSCHEM	1	1	1.3541118	1.6457	0.2082

All Participants
Engineer/Lab

In PFOSAA ppm
Summary of Fit

RSquare	0.181276
RSquare Adj	0.106847
Root Mean Square Error	1.272756
Mean of Response	-5.65628
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	11.836056	3.94535	2.4355
Error	33	53.456962	1.61991	Prob>F
C Total	36	65.293017		0.0822

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	32	53.443235	1.67010	121.6742
Pure Error	1	0.013726	0.01373	Prob>F
Total Error	33	53.456962		0.0717
Max RSq				
0.9998				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.677933	1.311276	-2.80	0.0084	-6.345727	-1.010138
GENDER[F-M]	-0.571849	0.25588	-2.23	0.0323	-1.092437	-0.051261
YRSCHEM	0.0270165	0.033456	0.81	0.4251	-0.04105	0.095083
AGE	-0.063657	0.040785	-1.56	0.1281	-0.146634	0.0193199

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	8.0905950	4.9945	0.0323
YRSCHEM	1	1	1.0563257	0.6521	0.4251
AGE	1	1	3.9462586	2.4361	0.1281

All Participants
Engineer/Lab

ln PFOSAA ppm
Summary of Fit

RSquare	0.1208[illegible]7
RSquare Adj	0.0691[illegible]1
Root Mean Square Error	1.299358
Mean of Response	-5.65628
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	7.889797	3.94490	2.3366
Error	34	57.403220	1.68833	Prob>F
C Total	36	65.293017		0.1120

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	19	31.922124	1.68011	0.9890
Pure Error	15	25.481096	1.69874	Prob>F
Total Error	34	57.403220		0.5166
Max RSq				
0.6097				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.660266	0.332941	-17.00	<.0001	-6.336879	-4.983654
GENDER[F-M]	-0.551158	0.260877	-2.11	0.0420	-1.081321	-0.020995
YRSCHEM	-0.018225	0.017056	-1.07	0.2928	-0.052886	0.016436

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	7.5359446	4.4635	0.0420
YRSCHEM	1	1	1.9278040	1.1418	0.2928

All Participants
Engineer/Lab

In M570ppm
Summary of Fit

RSquare	0.023179
RSquare Adj	-0.06562
Root Mean Square Error	0.990095
Mean of Response	-3.19558
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	0.767638	0.255879	0.2610
Error	33	32.349503	0.980288	Prob>F
C Total	36	33.117141		0.8529

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	32	32.253360	1.00792	10.4835
Pure Error	1	0.096143	0.09614	Prob>F
Total Error	33	32.349503		0.2406
Max RSq				
0.9971				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.483257	1.02006	-3.41	0.0017	-5.558572	-1.407941
GENDER[F-M]	-0.125208	0.199053	-0.63	0.5337	-0.530181	0.2797653
YRSCHEM	0.001537	0.026026	0.06	0.9533	-0.051413	0.0544869
AGE	0.0047368	0.031727	0.15	0.8822	-0.059812	0.0692859

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.38786407	0.3957	0.5337
YRSCHEM	1	1	0.00341911	0.0035	0.9533
AGE	1	1	0.02185078	0.0223	0.8822

All Participants
Engineer/Lab

In M570ppm

Summary of Fit

RSquare	0.02252
RSquare Adj	-0.03498
Root Mean Square Error	0.975755
Mean of Response	-3.19558
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.745787	0.372894	0.3917
Error	34	32.371354	0.952099	Prob>F
C Total	36	33.117141		0.6789

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	19	9.959941	0.52421	0.3509
Pure Error	15	22.411413	1.49409	Prob>F
Total Error	34	32.371354		0.9833
Max RSq				
0.3233				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.335748	0.250023	-13.34	<.0001	-3.843852	-2.827644
GENDER[F-M]	-0.126747	0.195906	-0.65	0.5220	-0.524874	0.2713797
YRSCHEM	0.0049036	0.012808	0.38	0.7042	-0.021125	0.0309325

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.39853117	0.4186	0.5220
YRSCHEM	1	1	0.13955278	0.1466	0.7042

All Participants
Engineer/Lab

ln PFOSA ppm
Summary of Fit

RSquare	0.022151
RSquare Adj	-0.06674
Root Mean Square Error	1.616733
Mean of Response	-5.7372
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	1.953947	0.65132	0.2492
Error	33	86.256256	2.61383	Prob>F
C Total	36	88.210203		0.8613

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	32	85.888903	2.68403	7.3064
Pure Error	1	0.367353	0.36735	Prob>F
Total Error	33	86.256256		0.2861
Max RSq				
0.9958				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.523456	1.665664	-3.32	0.0022	-8.912253	-2.134659
GENDER[F-M]	0.2341119	0.325034	0.72	0.4764	-0.427171	0.895395
YRSCHEM	0.0199578	0.042498	0.47	0.6417	-0.066504	0.10642
AGE	-0.00946	0.051808	-0.18	0.8562	-0.114862	0.0959429

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	1.3560164	0.5188	0.4764
YRSCHEM	1	1	0.5764525	0.2205	0.6417
AGE	1	1	0.0871452	0.0333	0.8562

All Participants
Engineer/Lab

ln PFOSA ppm
Summary of Fit

RSquare	0.021163
RSquare Adj	-0.03642
Root Mean Square Error	1.593585
Mean of Response	-5.7372
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	1.866802	0.93340	0.3676
Error	34	86.343402	2.53951	Prob>F
C Total	36	88.210203		0.6951

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	19	63.139191	3.32312	2.1482
Pure Error	15	23.204211	1.54695	Prob>F
Total Error	34	86.343402		0.0689
Max RSq				
0.7369				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.818037	0.408332	-14.25	<.0001	-6.647863	-4.988212
GENDER[F-M]	0.2371866	0.31995	0.74	0.4636	-0.413027	0.8873997
YRSCHEM	0.0132347	0.020918	0.63	0.5312	-0.029275	0.0557446

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	1.3956145	0.5496	0.4636
YRSCHEM	1	1	1.0165846	0.4003	0.5312

All Participants
Engineer/Lab

In M556 ppm
Summary of Fit

RSquare	0.114795
RSquare Adj	0.034322
Root Mean Square Error	1.165251
Mean of Response	-4.61966
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	5.810766	1.93692	1.4265
Error	33	44.807703	1.35781	Prob>F
C Total	36	50.618468		0.2526

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	32	44.781948	1.39944	54.3366
Pure Error	1	0.025755	0.02575	Prob>F
Total Error	33	44.807703		0.1071
Max RSq 0.9995				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-7.003379	1.200517	-5.83	<.0001	-9.445834	-4.560924
GENDER[F-M]	-0.103922	0.234267	-0.44	0.6602	-0.580538	0.372694
YRSCHEM	-0.045945	0.03063	-1.50	0.1431	-0.108262	0.0163723
AGE	0.0719096	0.03734	1.93	0.0628	-0.004059	0.1478779

Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.2671974	0.1968	0.6602
YRSCHEM	1	1	3.0550141	2.2500	0.1431
AGE	1	1	5.0357474	3.7087	0.0628

All Participants
Engineer/Lab

In M556 ppm
Summary of Fit

RSquare	0.015311
RSquare Adj	-0.04261
Root Mean Square Error	1.210778
Mean of Response	-4.61966
Observations (or Sum Wgts)	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.775018	0.38751	0.2643
Error	34	49.843450	1.46598	Prob>F
C Total	36	50.618468		0.7693

Lack of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack of Fit	19	18.113852	0.95336	0.4507
Pure Error	15	31.729598	2.11531	Prob>F
Total Error	34	49.843450		0.9486
Max RSq				
0.3732				

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.764061	0.310244	-15.36	<.0001	-5.394548	-4.133574
GENDER[F-M]	-0.127295	0.243093	-0.52	0.6039	-0.621316	0.3667259
YRSCHEM	0.0051619	0.015893	0.32	0.7473	-0.027136	0.0374602

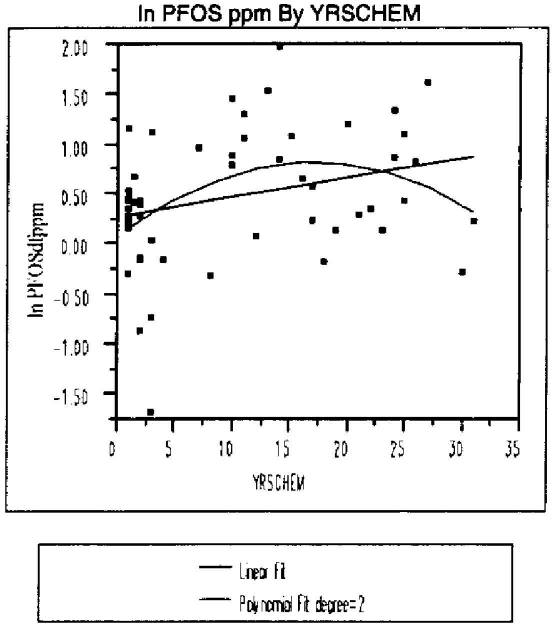
Effect Test

Source	Nparm	DF	Sum of Squares	F Ratio	Prob>F
GENDER	1	1	0.40198223	0.2742	0.6039
YRSCHEM	1	1	0.15464711	0.1055	0.7473

Appendix M

Scatterplots (and regressions) of fluorochemical levels of all chemical participant
male chemical operators (n = 52) and engineer/lab (n = 28)
with years worked in chemical

All Participants
Male Chemical Operators
ln PFOS ppm By YRSCHEM



Linear Fit

ln PFOSdfppm = 0.28294 + 0.01961 YRSCHEM

Summary of Fit

RSquare	0.07787
RSquare Adj	0.05943
Root Mean Square Error	0.6509
Mean of Response	0.49465
Observations (or Sum Wgts)	5

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.789373	1.78937	4.2227
Error	50	21.187429	0.42375	Prob>F
C Total	51	22.976802		0.0451

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.2829416	0.136981	2.07	0.0441	0.0078068	0.5580763
YRSCHEM	0.0196069	0.009541	2.05	0.0451	0.0004424	0.0387713

Polynomial Fit degree=2

ln PFOSdfppm = 0.07855 + 0.08713 YRSCHEM – 0.00255 YRSCHEM^2

Summary of Fit

RSquare	0.152148
RSquare Adj	0.117542
Root Mean Square Error	0.630532
Mean of Response	0.494658
Observations (or Sum Wgts)	52

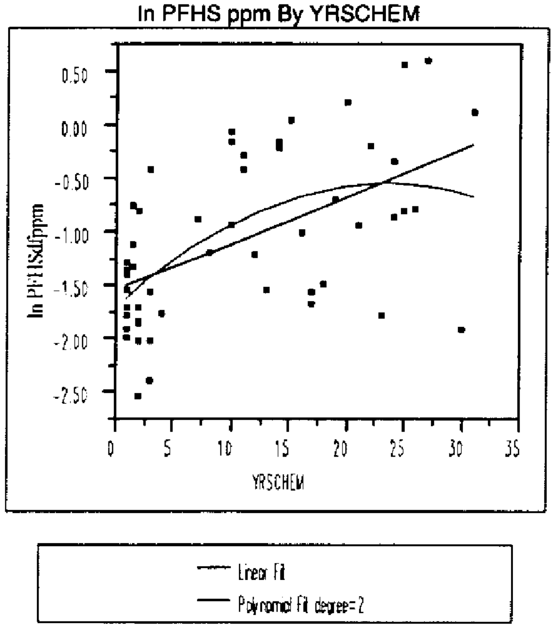
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	3.495868	1.74793	4.3965
Error	49	19.480934	0.39757	Prob>F
C Total	51	22.976802		0.0175

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0785522	0.16534	0.48	0.6368	-0.25371	0.4108141
YRSCHEM	0.0871341	0.033879	2.57	0.0132	0.0190526	0.1552157
YRSCHEM^2	-0.002546	0.001229	-2.07	0.0436	-0.005016	-0.000076

All Participants
Male Chemical Operators
ln PFHS ppm By YRSCHEM



Linear Fit
ln PFHSdfppm = -1.5385 + 0.04363 YRSCHEM

Summary of Fit

RSquare	0.293355
RSquare Adj	0.279222
Root Mean Square Error	0.653321
Mean of Response	-1.06736
Observations (or Sum Wgts)	52

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	8.859630	8.85963	20.7569
Error	50	21.341385	0.42683	Prob>F
C Total	51	30.201015		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.538462	0.137478	-11.19	<.0001	-1.814595	-1.262329
YRSCHEM	0.043628	0.009576	4.56	<.0001	0.0243941	0.0628619

Polynomial Fit degree=2

ln PFHSdfppm = -1.7114 + 0.10078 YRSCHEM – 0.00215 YRSCHEM^2

Summary of Fit

RSquare	0.33383
RSquare Adj	0.306639
Root Mean Square Error	0.640775
Mean of Response	-1.06736
Observations (or Sum Wgts)	52

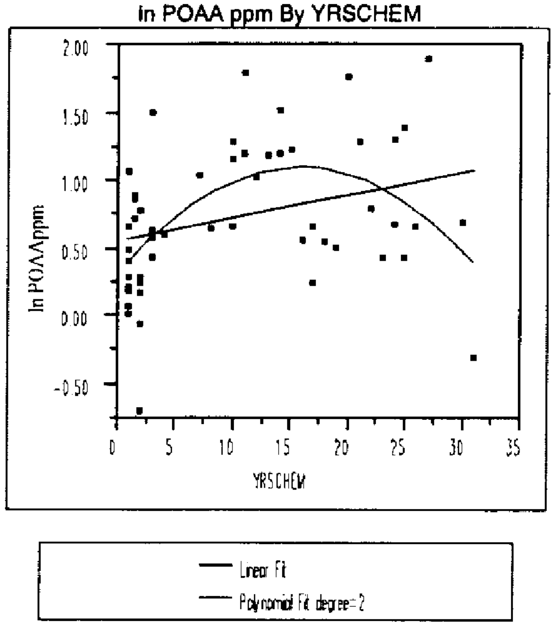
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	10.082003	5.04100	12.2774
Error	49	20.119012	0.41059	Prob>F
C Total	51	30.201015		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.711447	0.168026	-10.19	<.0001	-2.049106	-1.373787
YRSCHEM	0.1007796	0.034429	2.93	0.0052	0.0315921	0.1699671
YRSCHEM^2	-0.002155	0.001249	-1.73	0.0908	-0.004665	0.0003549

All Participants
Male Chemical Operators
ln POAA ppm By YRSCHEM



Linear Fit
ln POAAppm = 0.55713 + 0.01691 YRSCHEM

Summary of Fit

RSquare	0.09096
RSquare Adj	0.072779
Root Mean Square Error	0.515758
Mean of Response	0.739719
Observations (or Sum Wgts)	52

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.330847	1.33085	5.0031
Error	50	13.300322	0.26601	Prob>F
C Total	51	14.631169		0.0298

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.5571329	0.108531	5.13	<.0001	0.3391425	0.7751233
YRSCHEM	0.0169091	0.00756	2.24	0.0298	0.0017251	0.0320932

 3MA10050756

Polynomial Fit degree=2

ln POAAppm = 0.30559 + 0.10002 YRSCHEM − 0.00313 YRSCHEM^2

Summary of Fit

RSquare	0.26762
RSquare Adj	0.237727
Root Mean Square Error	0.467638
Mean of Response	0.739719
Observations (or Sum Wgts)	52

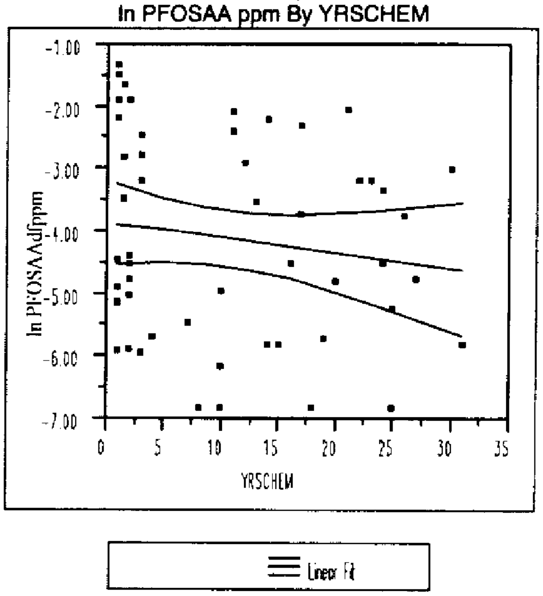
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	3.915590	1.95779	8.9526
Error	49	10.715579	0.21869	Prob>F
C Total	51	14.631169		0.0005

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3055886	0.122625	2.49	0.0161	0.0591644	0.5520129
YRSCHEM	0.1000157	0.025126	3.98	0.0002	0.0495226	0.1505088
YRSCHEM^2	-0.003133	0.000911	-3.44	0.0012	-0.004965	-0.001302

All Participants
Male Chemical Operators
ln PFOSAA ppm By YRSCHEM



Linear Fit
ln PFOSAAdfppm = -3.8496 – 0.02457 YRSCHEM

Summary of Fit

RSquare	0.021349
RSquare Adj	0.001776
Root Mean Square Error	1.604937
Mean of Response	-4.11489
Observations (or Sum Wgts)	52

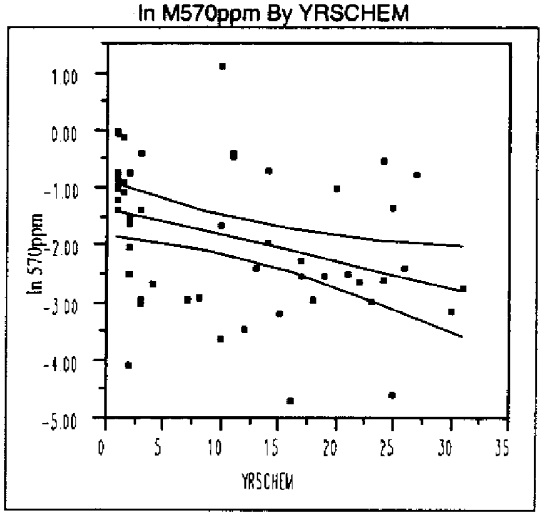
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.80958	2.80958	1.0908
Error	50	128.79120	2.57582	Prob>F
C Total	51	131.60078		0.3013

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.849596	0.337727	-11.40	<.0001	-4.527939	-3.171253
YRSCHEM	-0.024568	0.023524	-1.04	0.3013	-0.071818	0.0226812

All Participants
Male Chemical Operators
ln M570ppm By YRSCHEM



Linear Fit

Linear Fit
ln 570ppm = -1.3268 – 0.04752 YRSCHEM

Summary of Fit

RSquare	0.129273
RSquare Adj	0.111859
Root Mean Square Error	1.189837
Mean of Response	-1.83989
Observations (or Sum Wgts)	52

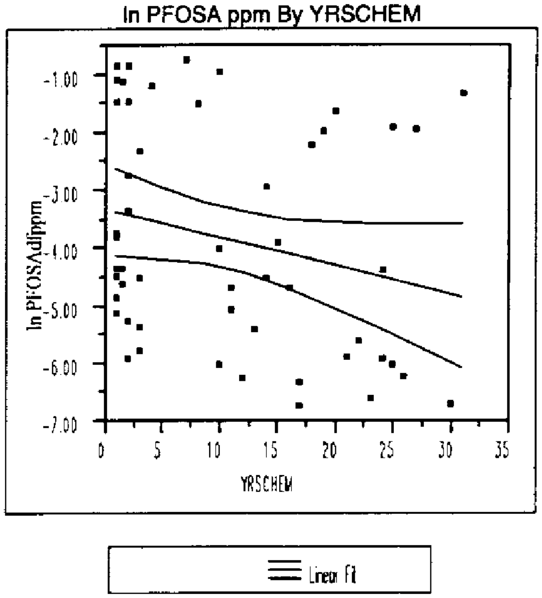
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	10.509261	10.5093	7.4233
Error	50	70.785564	1.4157	Prob>F
C Total	51	81.294825		0.0088

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.326808	0.250377	-5.30	<.0001	-1.829705	-0.823911
YRSCHEM	-0.047516	0.01744	-2.72	0.0088	-0.082545	-0.012487

All Participants
Male Chemical Operators
ln PFOSA ppm By YRSCHEM



Linear Fit
ln PFOSAdfppm = -3.3047 – 0.04865 YRSCHEM

Summary of Fit

RSquare	0.0581
RSquare Adj	0.039262
Root Mean Square Error	1.890083
Mean of Response	-3.83009
Observations (or Sum Wgts)	52

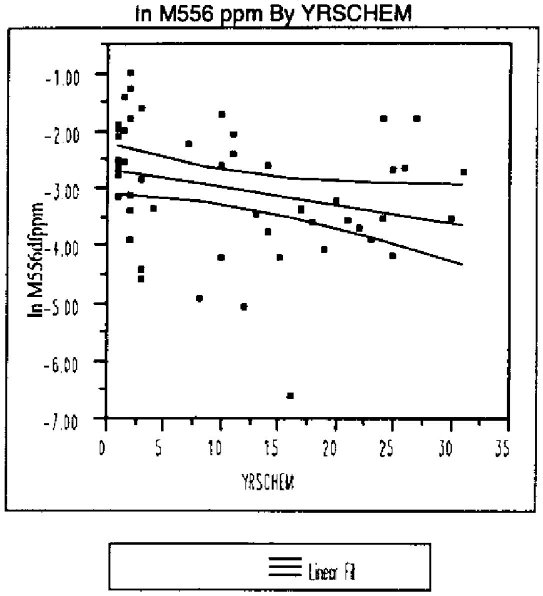
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	11.01808	11.0181	3.0842
Error	50	178.62062	3.5724	Prob>F
C Total	51	189.63870		0.0852

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.304729	0.39773	-8.31	<.0001	-4.103591	-2.505866
YRSCHEM	-0.048653	0.027704	-1.76	0.0852	-0.104298	0.0069914

All Participants
Male Chemical Operators
ln M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -2.6395 – 0.0315 YRSCHEM

Summary of Fit

RSquare	0.07551[illegible]
RSquare Adj	0.05702[illegible]
Root Mean Square Error	1.06350[illegible]
Mean of Response	-2.9796[illegible]
Observations (or Sum Wgts)	5[illegible]

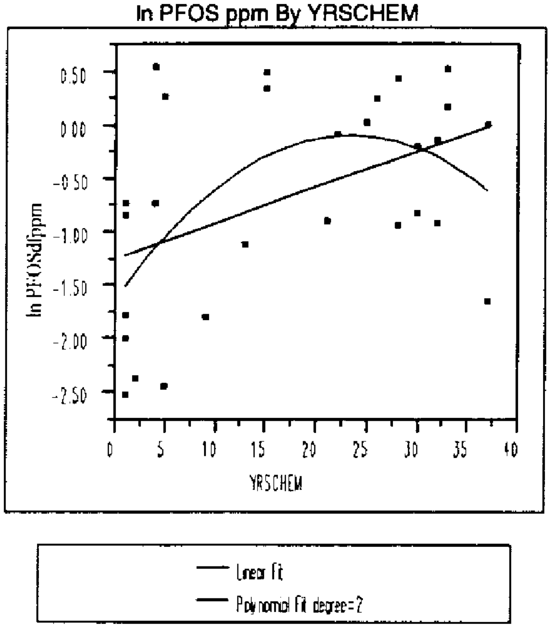
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.619303	4.61930	4.0841
Error	50	56.552145	1.13104	Prob>F
C Total	51	61.171448		0.0487

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.639497	0.223793	-11.79	<.0001	-3.088999	-2.189996
YRSCHEM	-0.031503	0.015588	-2.02	0.0487	-0.062812	-0.000193

All Participants
Male Engineer/Lab
ln PFOS ppm By YRSCHEM



Linear Fit
ln PFOSdfppm = -1.2515 + 0.03365 YRSCHEM

Summary of Fit

RSquare	0.20812
RSquare Adj	0.17766
Root Mean Square Error	0.88612
Mean of Response	-0.6614
Observations (or Sum Wgts)	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	5.365639	5.36564	6.8333
Error	26	20.415689	0.78522	Prob>F
C Total	27	25.781328		0.0147

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.251482	0.28106	-4.45	0.0001	-1.829204	-0.673759
YRSCHEM	0.0336488	0.012872	2.61	0.0147	0.0071897	0.0601078

Polynomial Fit degree=2

$\ln PFOSdfppm = -1.6361 + 0.13222\ YRSCHEM - 0.00282\ YRSCHEM^2$

Summary of Fit

RSquare	0.307474
RSquare Adj	0.252072
Root Mean Square Error	0.845086
Mean of Response	-0.66143
Observations (or Sum Wgts)	28

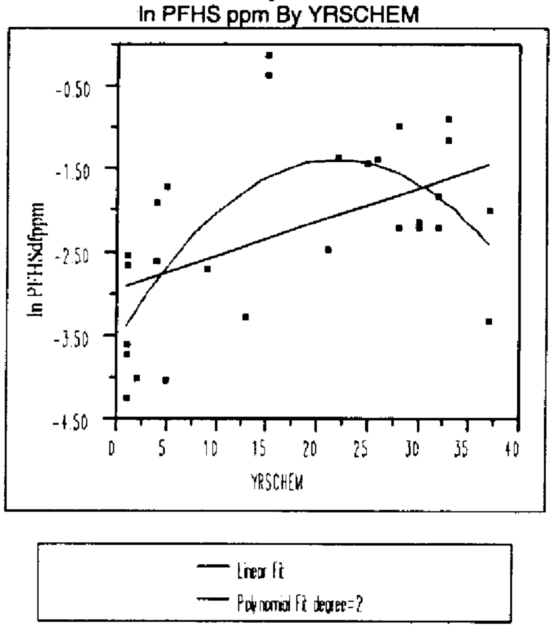
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	7.927078	3.96354	5.5499
Error	25	17.854250	0.71417	Prob>F
C Total	27	25.781328		0.0101

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.636113	0.336297	-4.87	<.0001	-2.328723	-0.943503
YRSCHEM	0.1322248	0.053479	2.47	0.0206	0.0220833	0.2423664
YRSCHEM^2	-0.002819	0.001489	-1.89	0.0699	-0.005885	0.0002466

All Participants
Male Engineer/Lab
ln PFHS ppm By YRSCHEM



Linear Fit

ln PFHSdfppm = -2.9522 + 0.04106 YRSCHEM

Summary of Fit

RSquare	0.243114
RSquare Adj	0.214003
Root Mean Square Error	0.978058
Mean of Response	-2.23224
Observations (or Sum Wgts)	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	7.988791	7.98879	8.3513
Error	26	24.871516	0.95660	Prob>F
C Total	27	32.860307		0.0077

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.95222	0.310219	-9.52	<.0001	-3.589879	-2.314561
YRSCHEM	0.0410581	0.014208	2.89	0.0077	0.0118541	0.0702621

Polynomial Fit degree=2

ln PFHSdfppm = -3.5713 + 0.19973 YRSCHEM – 0.00454 YRSCHEM^2

Summary of Fit

RSquare	0.445082
RSquare Adj	0.400688
Root Mean Square Error	0.854044
Mean of Response	-2.23224
Observations (or Sum Wgts)	28

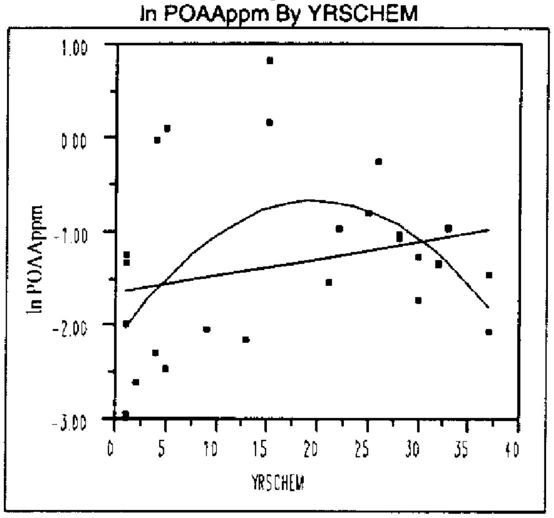
Analysis of Variance

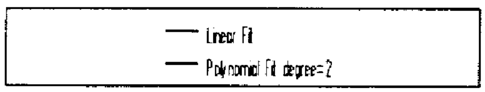
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	14.625528	7.31276	10.0258
Error	25	18.234779	0.72939	Prob>F
C Total	27	32.860307		0.0006

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.571347	0.339861	-10.51	<.0001	-4.2713	-2.871395
YRSCHEM	0.1997324	0.054046	3.70	0.0011	0.0884234	0.3110415
YRSCHEM^2	-0.004538	0.001504	-3.02	0.0058	-0.007636	-0.00144

All Participants
Male Engineer/Lab
ln POAAppm By YRSCHEM





Linear Fit

ln POAAppm = -1.6429 + 0.01806 YRSCHEM

Summary of Fit

RSquare	0.063628
RSquare Adj	0.027613
Root Mean Square Error	0.935202
Mean of Response	-1.32623
Observations (or Sum Wgts)	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.545191	1.54519	1.7667
Error	26	22.739675	0.87460	Prob>F
C Total	27	24.284865		0.1953

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.642879	0.296626	-5.54	<.0001	-2.252597	-1.03316
YRSCHEM	0.0180572	0.013585	1.33	0.1953	-0.009867	0.0459816

Polynomial Fit degree=2

ln POAAppm = -2.1643 + 0.15169 YRSCHEM – 0.00382 YRSCHEM^2

Summary of Fit

RSquare	0.257455
RSquare Adj	0.198052
Root Mean Square Error	0.849296
Mean of Response	-1.32623
Observations (or Sum Wgts)	28

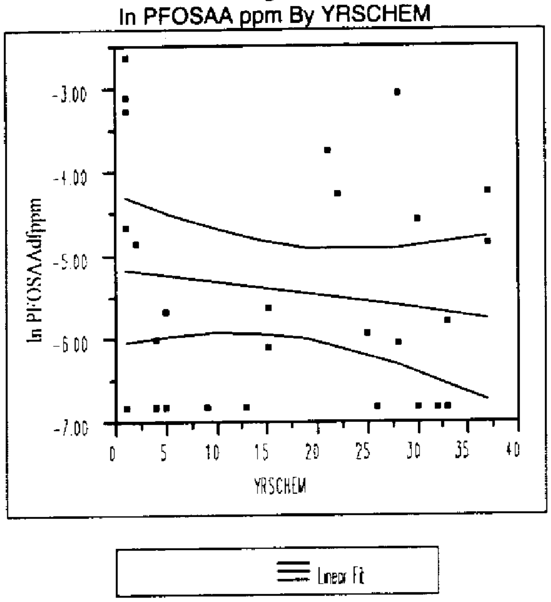
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	6.252264	3.12613	4.3340
Error	25	18.032601	0.72130	Prob>F
C Total	27	24.284865		0.0242

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.164287	0.337972	-6.40	<.0001	2.860348	-1.468226
YRSCHEM	0.1516874	0.053746	2.82	0.0092	0.0409971	0.2623777
YRSCHEM^2	-0.003821	0.001496	-2.55	0.0171	0.006902	-0.000741

All Participants
Male Engineer/Lab
ln PFOSAA ppm By YRSCHEM



Linear Fit

ln PFOSAAdfppm = -5.1411 – 0.0164 YRSCHEM

Summary of Fit

RSquare	0.024437
RSquare Adj	-0.01308
Root Mean Square Error	1.399249
Mean of Response	-5.4287
Observations (or Sum Wgts)	28

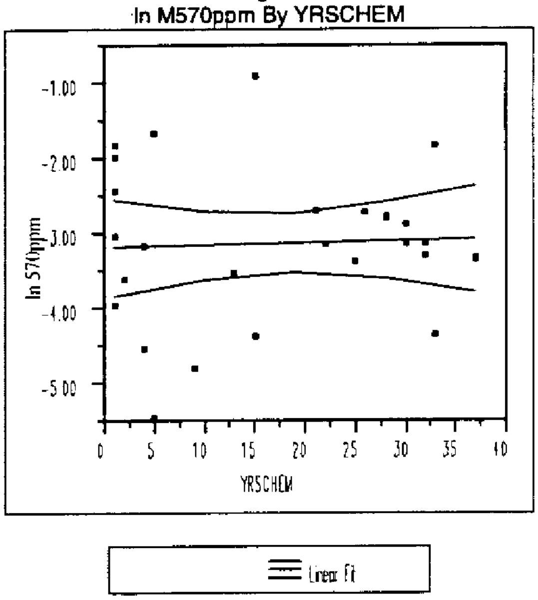
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.275122	1.27512	0.6513
Error	26	50.905372	1.95790	Prob>F
C Total	27	52.180494		0.4270

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.141055	0.443812	-11.58	<.0001	-6.053316	-4.228794
YRSCHEM	-0.016403	0.020326	-0.81	0.4270	-0.058184	0.0253771

All Participants
Male Engineer/Lab
ln M570ppm By YRSCHEM



Linear Fit

ln 570ppm = -3.1804 + 0.00328 YRSCHEM

Summary of Fit

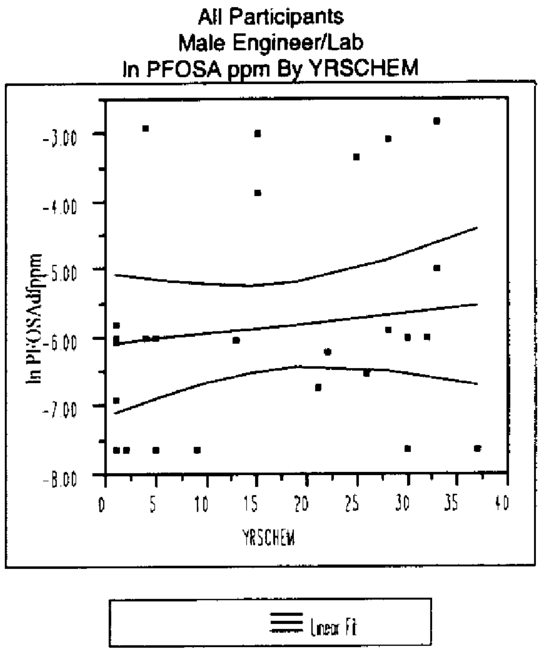
RSquare	0.00186
RSquare Adj	-0.03653
Root Mean Square Error	1.024495
Mean of Response	-3.12301
Observations (or Sum Wgts)	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.050840	0.05084	0.0484
Error	26	27.289336	1.04959	Prob>F
C Total	27	27.340175		0.8275

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.180449	0.324948	-9.79	<.0001	-3.848383	-2.512515
YRSCHEM	0.0032754	0.014882	0.22	0.8275	-0.027315	0.033866



Linear Fit

ln PFOSAdfppm = -6.0798 + 0.01464 YRSCHEM

Summary of Fit

RSquare	0.014659
RSquare Adj	-0.02324
Root Mean Square Error	1.620061
Mean of Response	-5.82314
Observations (or Sum Wgts)	28

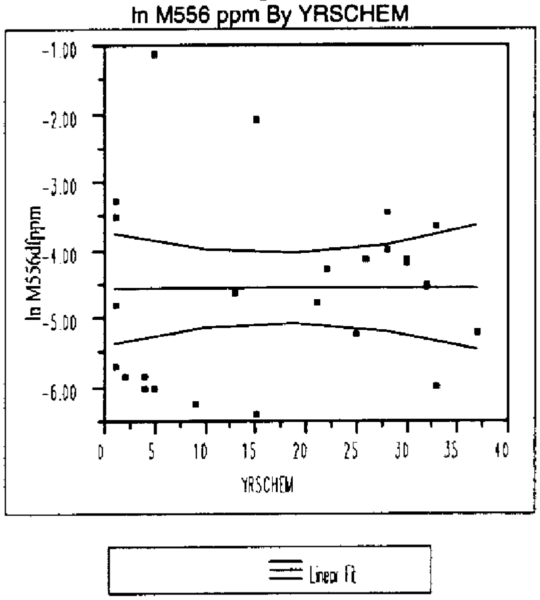
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.015219	1.01522	0.3868
Error	26	68.239528	2.62460	Prob>F
C Total	27	69.254747		0.5394

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-6.079806	0.513848	-11.83	<.0001	-7.136028	-5.023584
YRSCHEM	0.0146365	0.023534	0.62	0.5394	-0.033737	0.0630103

All Participants
Male Engineer/Lab
ln M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -4.5528 + 0.00037 YRSCHEM

Summary of Fit

RSquare	0.000015
RSquare Adj	-0.03845
Root Mean Square Error	1.297208
Mean of Response	-4.54625
Observations (or Sum Wgts)	28

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.000661	0.00066	0.0004
Error	26	43.751480	1.68275	Prob>F
C Total	27	43.752141		0.9843

Parameter Estimates

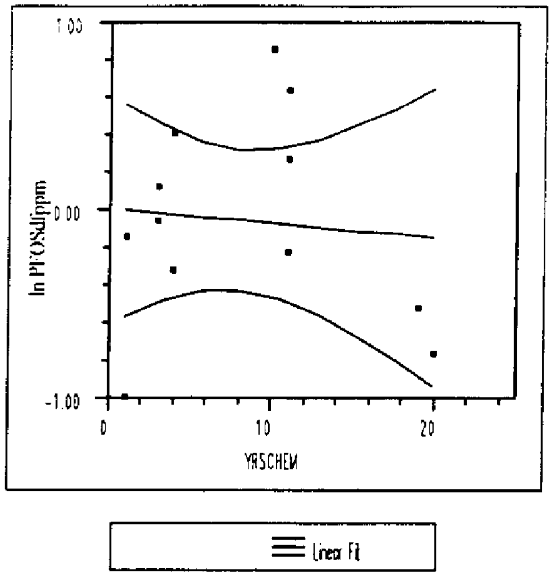
Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.552795	0.411446	-11.07	<.0001	-5.398529	-3.707061
YRSCHEM	0.0003734	0.018844	0.02	0.9843	-0.03836	0.039107

Appendix N

Scatterplots (and regressions) of fluorochemical levels of all chemical participant
female chemical operators (n = 12) and engineer/lab (n = 9)
with years worked in chemical

All Participants
Female Chemcial Operators

In PFOS ppm By YRSCHEM



Linear Fit
In PFOSdfppm = 0.01226 – 0.00779 YRSCHEM

Summary of Fit

RSquare	0.008557
RSquare Adj	-0.09059
Root Mean Square Error	0.578093
Mean of Response	-0.05134
Observations (or Sum Wgts)	12

Analysis of Variance

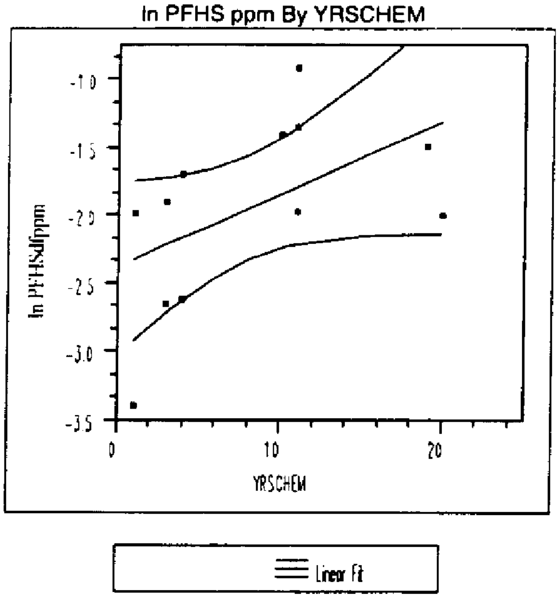
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0288427	0.028843	0.0863
Error	10	3.3419208	0.334192	Prob>F
C Total	11	3.3707635		0.7749

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.0122559	0.273326	0.04	0.9651	-0.596757	0.6212687
YRSCHEM	-0.007787	0.026506	-0.29	0.7749	-0.066847	0.0512728

All Participants
Female Chemcial Operators

In PFHS ppm By YRSCHEM



Linear Fit
ln PFHSdfppm = -2.3774 + 0.05385 YRSCHEM

Summary of Fit

RSquare	0.275351
RSquare Adj	0.202886
Root Mean Square Error	0.602463
Mean of Response	-1.93766
Observations (or Sum Wgts)	12

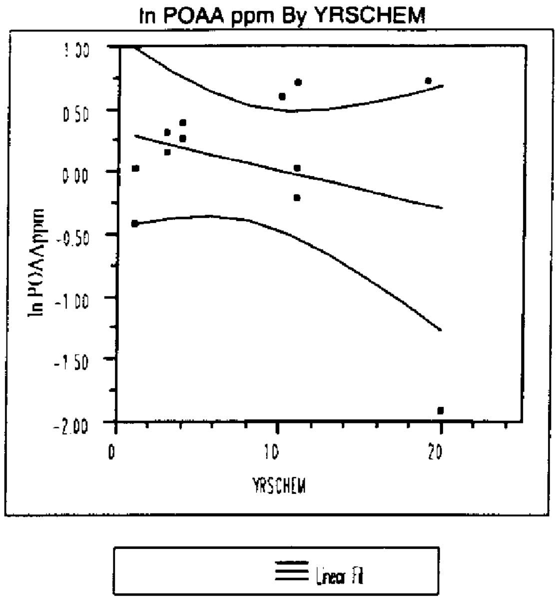
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.3791706	1.37917	3.7998
Error	10	3.6296113	0.36296	Prob>F
C Total	11	5.0087819		0.0798

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.377407	0.284848	-8.35	<.0001	-3 012092	-1.742721
YRSCHEM	0.0538465	0.027623	1.95	0.0798	-0 007703	0.1153959

All Participants
Female Chemcial Operators



Linear Fit

ln POAAppm = 0.32148 – 0.03055 YRSCHEM

Summary of Fit

RSquare	0.079815
RSquare Adj	-0.0122
Root Mean Square Error	0.715366
Mean of Response	0.072008
Observations (or Sum Wgts)	12

Analysis of Variance

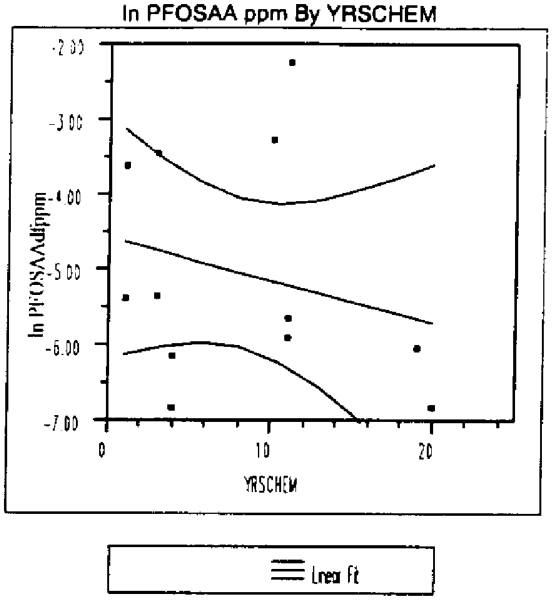
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.4438781	0.443878	0.8674
Error	10	5.1174828	0.511748	Prob>F
C Total	11	5.5613609		0.3736

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	0.3214819	0.33823	0.95	0.3643	-0.432145	1.075109
YRSCHEM	-0.030548	0.0328	-0.93	0.3736	-0.103632	0.0425361

All Participants
Female Chemcial Operators

In PFOSAA ppm By YRSCHEM



Linear Fit
ln PFOSAAdfppm = -4.5678 – 0.0569 YRSCHEM

Summary of Fit

RSquare	0.06068
RSquare Adj	-0.03325
Root Mean Square Error	1.543965
Mean of Response	-5.0325
Observations (or Sum Wgts)	12

Analysis of Variance

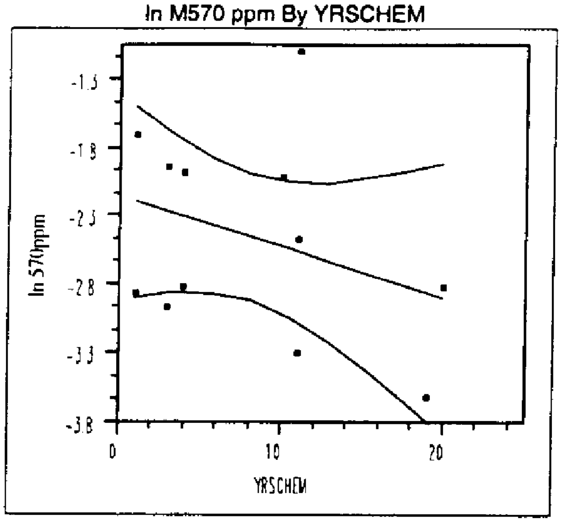
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.539949	1.53995	0.6460
Error	10	23.838281	2.38383	Prob>F
C Total	11	25.378230		0.4402

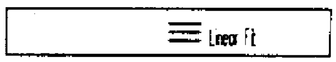
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.56783	0.729997	-6.26	<.0001	-6.194374	-2.941286
YRSCHEM	-0.056899	0.070792	-0.80	0.4402	-0.214635	0.1008375

All Participants
Female Chemcial Operators

ln M570 ppm By YRSCHEM





Linear Fit

ln 570ppm = -2.1009 – 0.0371 YRSCHEM

Summary of Fit

RSquare	0.111759
RSquare Adj	0.022934
Root Mean Square Error	0.721322
Mean of Response	-2.40387
Observations (or Sum Wgts)	12

Analysis of Variance

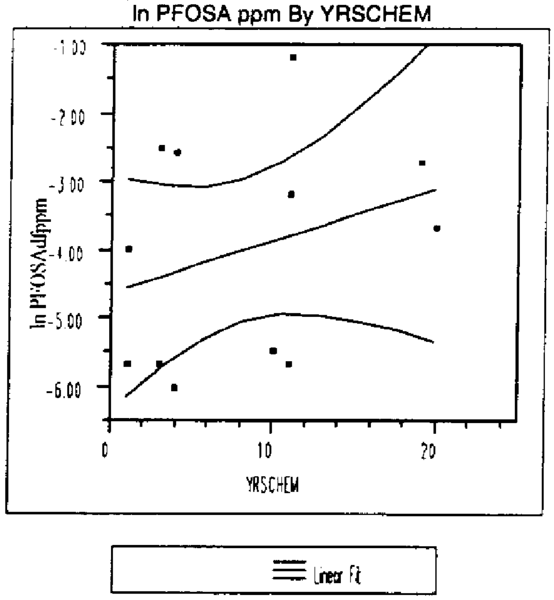
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.6546479	0.654648	1.2582
Error	10	5.2030495	0.520305	Prob>F
C Total	11	5.8576974		0.2882

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.100903	0.341046	-6.16	0.0001	-2.860804	-1.341001
YRSCHEM	-0.037098	0.033073	-1.12	0.2882	-0.110791	0.0365942

All Participants
Female Chemcial Operators

In PFOSA ppm By YRSCHEM



Linear Fit
ln PFOSAdfppm = -4.6226 + 0.0764 YRSCHEM

Summary of Fit

RSquare	0.095234
RSquare Adj	0.004758
Root Mean Square Error	1.624037
Mean of Response	-3.99866
Observations (or Sum Wgts)	12

Analysis of Variance

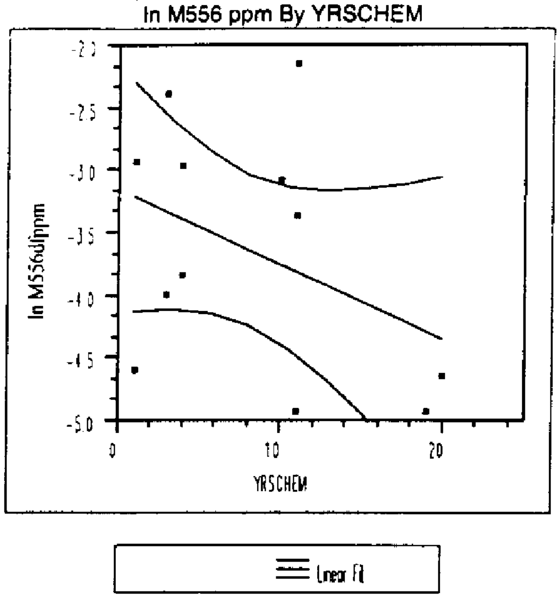
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.776184	2.77618	1.0526
Error	10	26.374947	2.63749	Prob>F
C Total	11	29.151132		0.3291

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.622563	0.767855	-6.02	0.0001	-6.333461	-2.911665
YRSCHEM	0.0763964	0.074464	1.03	0.3291	-0.08952	0.2423128

All Participants
Female Chemcial Operators

In M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -3.1494 - 0.05942 YRSCHEM

Summary of Fit

RSquare	0.159673
RSquare Adj	0.075641
Root Mean Square Error	0.940158
Mean of Response	-3.63466
Observations (or Sum Wgts)	12

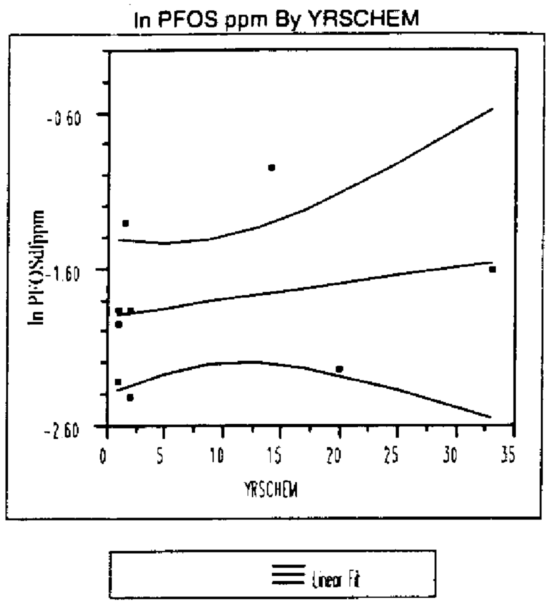
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	1.679525	1.67953	1.9001
Error	10	8.838975	0.88390	Prob>F
C Total	11	10.518500		0.1981

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.149387	0.444513	-7.09	<.0001	-4.13983	-2.158945
YRSCHEM	-0.059421	0.043107	-1.38	0.1981	-0.155471	0.0366281

All Participants
Female Engineer/Lab



Linear Fit

ln PFOSdfppm = -1.8939 + 0.01024 YRSCHEM

Summary of Fit

RSquare	0.058759
RSquare Adj	-0.0757
Root Mean Square Error	0.505477
Mean of Response	-1.80801
Observations (or Sum Wgts)	9

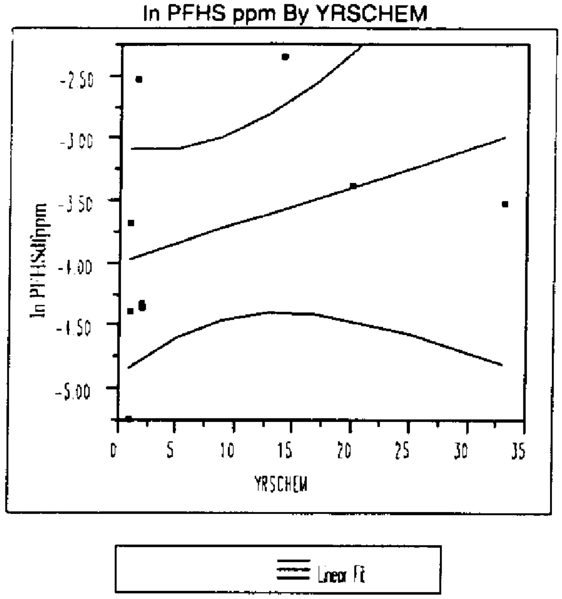
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.1116544	0.111654	0.4370
Error	7	1.7885504	0.255507	Prob>F
C Total	8	1.9002048		0.5297

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-1.893913	0.212779	-8.90	<.0001	-2.397059	-1.390766
YRSCHEM	0.0102397	0.01549	0.66	0.5297	-0.026388	0.0468678

All Participants
Female Engineer/Lab



Linear Fit

ln PFHSdfppm = -3.9868 + 0.03015 YRSCHEM

Summary of Fit

RSquare	0.138988
RSquare Adj	0.015987
Root Mean Square Error	0.925469
Mean of Response	-3.73389
Observations (or Sum Wgts)	9

Analysis of Variance

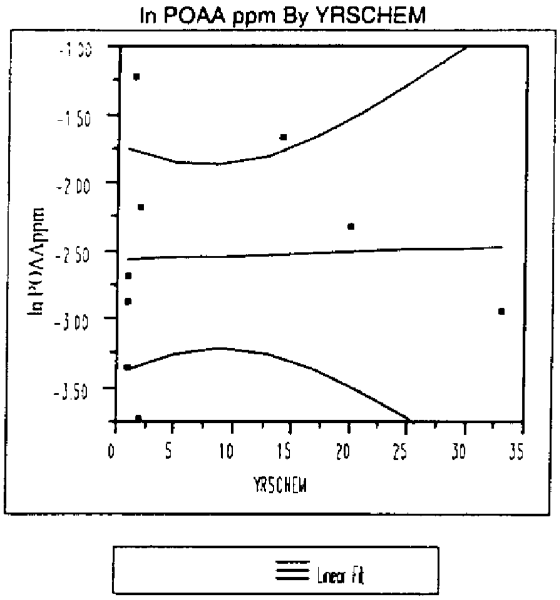
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.9678134	0.967813	1.1300
Error	7	5.9954503	0.856493	Prob>F
C Total	8	6.9632637		0.3231

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.986788	0.389573	-10.23	<.0001	-4.90799	-3.065586
YRSCHEM	0.030147	0.02836	1.06	0.3231	-0.036915	0.0972088

3MA10050781

All Participants
Female Engineer/Lab



Linear Fit

ln POAAppm = -2.5628 + 0.00289 YRSCHEM

Summary of Fit

RSquare	0.001765
RSquare Adj	-0.14084
Root Mean Square Error	0.848257
Mean of Response	-2.53853
Observations (or Sum Wgts)	9

Analysis of Variance

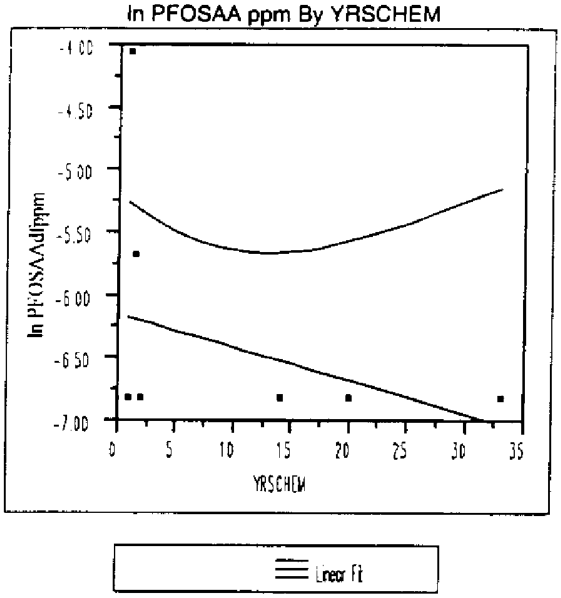
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0089035	0.008904	0.0124
Error	7	5.0367756	0.719539	Prob>F
C Total	8	5.0456791		0.9145

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.562785	0.357071	-7.18	0.0002	-3.40713	-1.718439
YRSCHEM	0.0028915	0.025994	0.11	0.9145	-0.058575	0.0643584

All Participants
Female Engineer/Lab

In PFOSAA ppm By YRSCHEM



Linear Fit

ln PFOSAAdfppm = -6.1434 – 0.02633 YRSCHEM

Summary of Fit

RSquare	0.103266
RSquare Adj	-0.02484
Root Mean Square Error	0.957088
Mean of Response	-6.36431
Observations (or Sum Wgts)	9

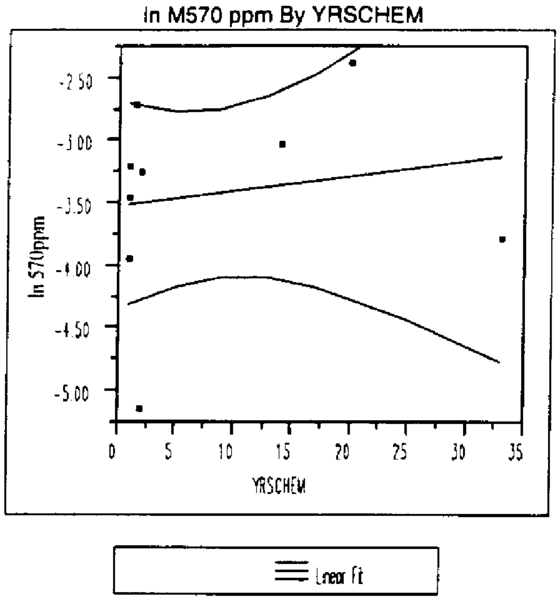
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.7384073	0.738407	0.8061
Error	7	6.4121225	0.916018	Prob>F
C Total	8	7.1505298		0.3991

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-6.143411	0.402883	-15.25	<.0001	-7.096087	-5.190736
YRSCHEM	-0.026333	0.029329	-0.90	0.3991	-0.095686	0.0430203

All Participants
Female Engineer/Lab



Linear Fit

ln 570ppm = -3.5233 + 0.01215 YRSCHEM

Summary of Fit

RSquare	0.030399
RSquare Adj	-0.10812
Root Mean Square Error	0.846298
Mean of Response	-3.42136
Observations (or Sum Wgts)	9

Analysis of Variance

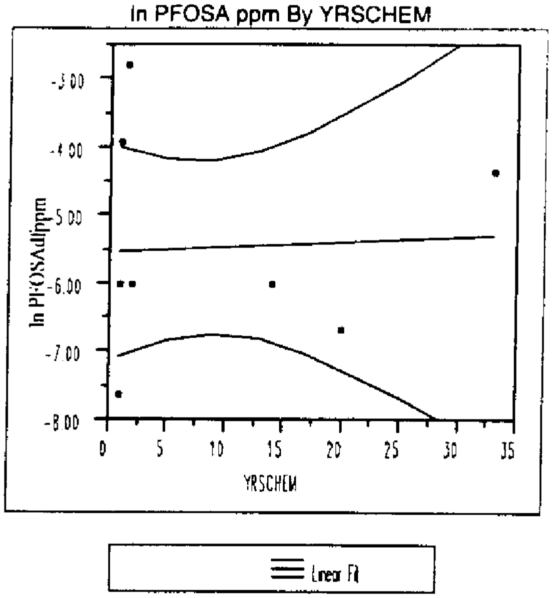
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.1571845	0.157185	0.2195
Error	7	5.0135469	0.716221	Prob>F
C Total	8	5.1707315		0.6537

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.523279	0.356247	-9.89	<.0001	-4.365676	-2.680883
YRSCHEM	0.0121493	0.025934	0.47	0.6537	-0.049176	0.0734743

All Participants
Female Engineer/Lab

In PFOSA ppm By YRSCHEM



Linear Fit
ln PFOSAdfppm = -5.5285 + 0.007 YRSCHEM

Summary of Fit

RSquare	0.002879
RSquare Adj	-0.13957
Root Mean Square Error	1.605932
Mean of Response	-5.46983
Observations (or Sum Wgts)	9

Analysis of Variance

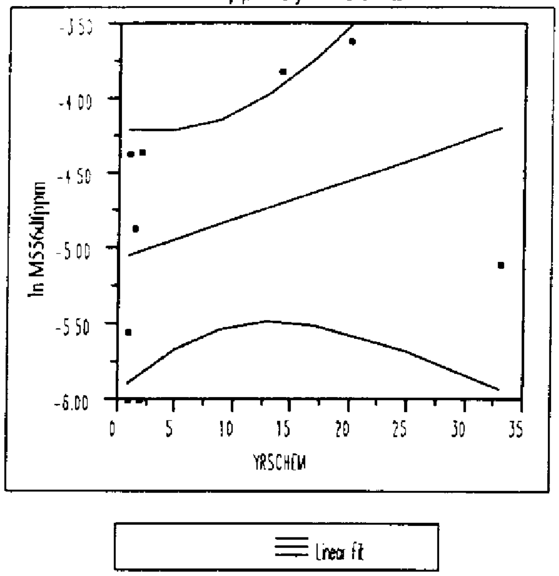
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.052123	0.05212	0.0202
Error	7	18.053117	2.57902	Prob>F
C Total	8	18.105239		0.8910

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.528517	0.676012	-8.18	<.0001	-7.127044	-3.929989
YRSCHEM	0.0069962	0.049212	0.14	0.8910	-0.109374	0.123366

All Participants
Female Engineer/Lab

In M556 ppm By YRSCHEM



Linear Fit

ln M556dfppm = -5.0701 + 0.02647 YRSCHEM

Summary of Fit

RSquare	0.119476
RSquare Adj	-0.00631
Root Mean Square Error	0.886382
Mean of Response	-4.84805
Observations (or Sum Wgts)	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.7462412	0.746241	0.9498
Error	7	5.4997153	0.785674	Prob>F
C Total	8	6.2459565		0.3622

Parameter Estimates

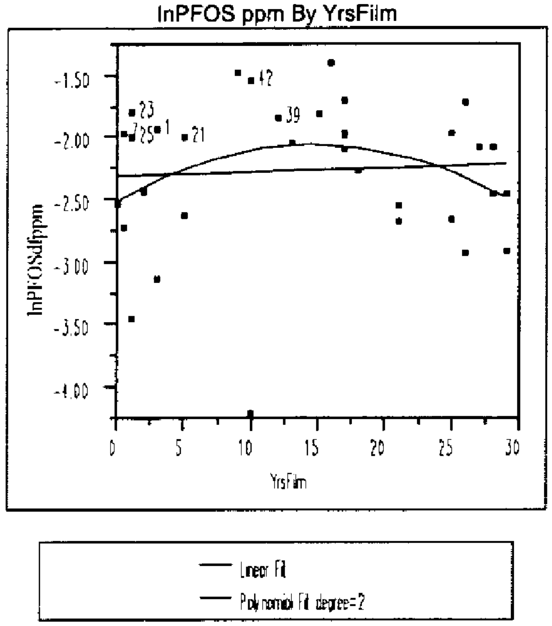
Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.070124	0.37312	-13.59	<.0001	-5.952419	-4.187828
YRSCHEM	0.026472	0.027162	0.97	0.3622	-0.037757	0.0907015

Appendix O

Scatterplots (and regressions) of fluorochemical levels of random sample who worked were only in the film plant (n = 36) with years worked in film

Random Sample
Only Film Employees
(Maintenance Workers Numbered)

lnPFOS ppm By YrsFilm



Linear Fit
lnPFOSdfppm = -2.3024 + 0.00313 YrsFilm
Summary of Fit

RSquare	0.002948
RSquare Adj	-0.02638
Root Mean Square Error	0.585965
Mean of Response	-2.25946
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.034516	0.034516	0.1005
Error	34	11.674079	0.343355	Prob>F
C Total	35	11.708595		0.7531

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.30237	0.166902	-13.79	<.0001	-2.641553	-1.963187
YrsFilm	0.0031336	0.009883	0.32	0.7531	-0.016952	0.0232187

Polynomial Fit degree=2

lnPFOSdfppm = -2.5117 + 0.06209 YrsFilm – 0.0021 YrsFilm^2

Summary of Fit

RSquare	0.083482
RSquare Adj	0.027935
Root Mean Square Error	0.570251
Mean of Response	-2.25946
Observations (or Sum Wgts)	36

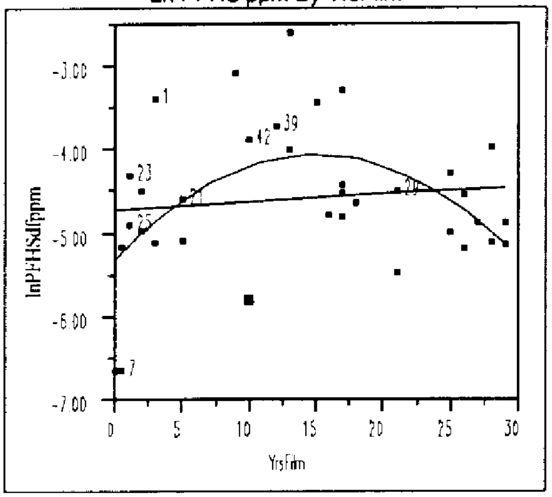
Analysis of Variance

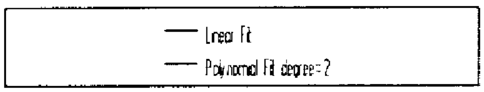
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.977453	0.488726	1.5029
Error	33	10.731142	0.325186	Prob>F
C Total	35	11.708595		0.2373

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-2.511702	0.203701	-12.33	<.0001	-2.926132	-2.097272
YrsFilm	0.062089	0.035933	1.73	0.0934	-0.011017	0.1351945
YrsFilm^2	-0.002097	0.001231	-1.70	0.0980	-0.004602	0.0004084

Random Sample
Only Film Employees
Ln PFHS ppm By YrsFilm





Linear Fit

lnPFHSdfppm = -4.7215 + 0.00958 YrsFilm

Summary of Fit

RSquare	0.011809
RSquare Adj	-0.01814
Root Mean Square Error	0.882741
Mean of Response	-4.58683
Observations (or Sum Wgts)	35

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.307286	0.307286	0.3943
Error	33	25.714619	0.779231	Prob>F
C Total	34	26.021905		0.5343

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-4.721471	0.26122	-18.07	<.0001	-5.252924	-4.190018
YrsFilm	0.0095783	0.015253	0.63	0.5343	-0.021454	0.0406102

Polynomial Fit degree=2

lnPFHSdfppm = -5.3019 + 0.16523 YrsFilm – 0.00548 YrsFilm^2

Summary of Fit

RSquare	0.252796
RSquare Adj	0.206096
Root Mean Square Error	0.779496
Mean of Response	-4.58683
Observations (or Sum Wgts)	35

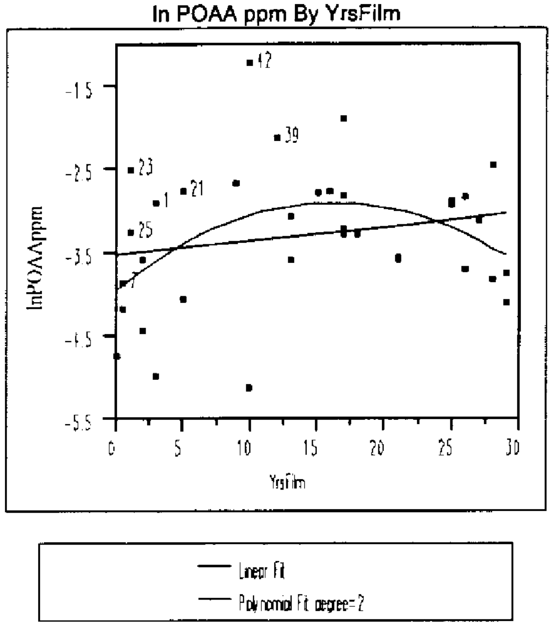
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	6.578235	3.28912	5.4132
Error	32	19.443670	0.60761	Prob>F
C Total	34	26.021905		0.0094

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-5.301864	0.292996	-18.10	<.0001	-5.898674	-4.705053
YrsFilm	0.1652333	0.050289	3.29	0.0025	0.0627984	0.2676682
YrsFilm^2	-0.005481	0.001706	-3.21	0.0030	-0.008957	-0.002006

Random Sample
Only Film Employees
(Maintenance Workers Numbered)



Linear Fit
lnPOAAppm = -3.5336 + 0.01719 YrsFilm
Summary of Fit

RSquare	0.040923
RSquare Adj	0.01186
Root Mean Square Error	0.838584
Mean of Response	-3.29191
Observations (or Sum Wgts)	35

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.990187	0.990187	1.4081
Error	33	23.206369	0.703223	Prob>F
C Total	34	24.196556		0.2438

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-3.533607	0.248153	-14.24	<.0001	-4.038476	-3.028739
YrsFilm	0.017194	0.01449	1.19	0.2438	-0.012286	0.0466736

Polynomial Fit degree=2

lnPOAAppm = -3.9585 + 0.13115 YrsFilm – 0.00401 YrsFilm^2

Summary of Fit

RSquare	0.179823
RSquare Adj	0.128562
Root Mean Square Error	0.787509
Mean of Response	-3.29191
Observations (or Sum Wgts)	35

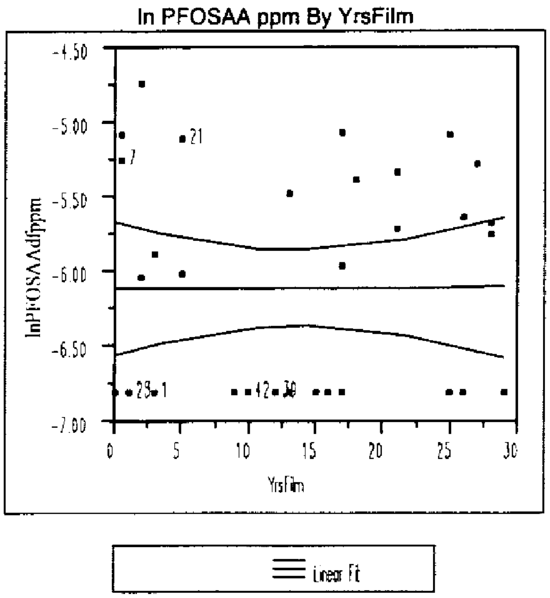
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	4.351095	2.17555	3.5080
Error	32	19.845461	0.62017	Prob>F
C Total	34	24.196556		0.0419

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-3.958504	0.296008	-13.37	<.0001
YrsFilm	0.1311467	0.050806	2.58	0.0146
YrsFilm^2	-0.004013	0.001724	-2.33	0.0264

Random Sample
Only Film Employees
(Maintenance Workers Numbered)



Linear Fit
lnPFOSAAdfppm = -6.1143 + 0.00041 YrsFilm

Summary of Fit

RSquare	0.000031
RSquare Adj	-0.03027
Root Mean Square Error	0.739574
Mean of Response	-6.10856
Observations (or Sum Wgts)	35

Analysis of Variance

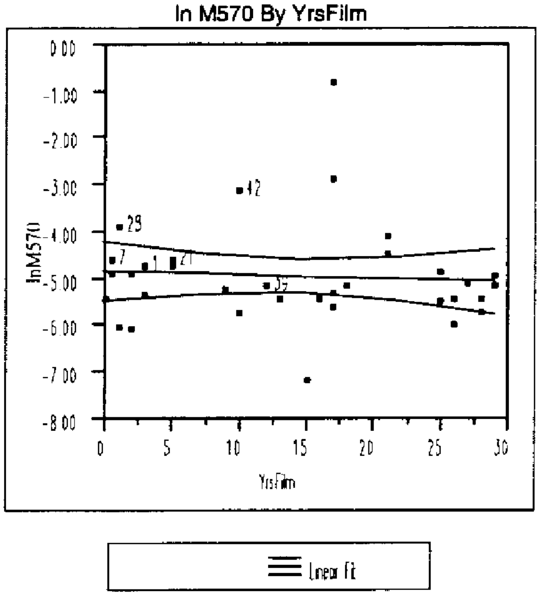
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.000553	0.000553	0.0010
Error	33	18.050011	0.546970	Prob>F
C Total	34	18.050564		0.9748

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-6.114269	0.218854	-27.94	<.0001	-6.559529	-5.66901
YrsFilm	0.0004063	0.012779	0.03	0.9748	-0.025593	0.0264053

Random Sample
Only Film Employees
(Maintenance Workers Numbered)

ln M570 By YrsFilm



Linear Fit

lnM570 = -4.8046 - 0.00844 YrsFilm

Summary of Fit

RSquare	0.006167
RSquare Adj	-0.02306
Root Mean Square Error	1.089533
Mean of Response	-4.92021
Observations (or Sum Wgts)	36

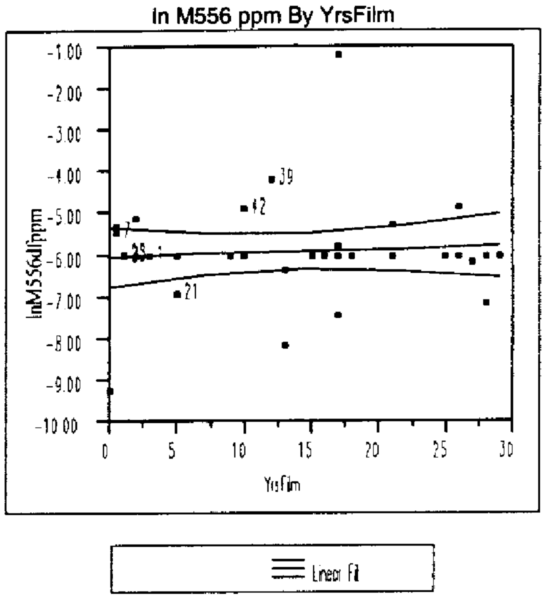
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.250458	0.25046	0.2110
Error	34	40.360826	1.18708	Prob>F
C Total	35	40.611285		0.6489

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-4.804612	0.310334	-15.48	<.0001
YrsFilm	-0.008441	0.018377	-0.46	0.6489

Random Sample
Only Film Employees
(Maintenance Workers Numbered)



Linear Fit

lnM556dfppm = -6.0381 + 0.00926 YrsFilm

Summary of Fit

RSquare	0.005982
RSquare Adj	-0.02325
Root Mean Square Error	1.213109
Mean of Response	-5.91136
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.301128	0.30113	0.2046
Error	34	50.035524	1.47163	Prob>F
C Total	35	50.336652		0.6539

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-6.038109	0.345532	-17.47	<.0001
YrsFilm	0.0092556	0.020461	0.45	0.6539